



Istituto Nazionale
di Fisica Nucleare

SEZIONE DI BOLOGNA

AMS-02-TOF

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1. SCOPE

This document contains the results of the U-TOF Flight model (FM) vibration test executed by INFN (BO) in the SERMS facility in 11-14/09/2007(test setup and fixture characterization) and 17-21/09/2007 (test setup, UTOF vibration test and setup dismantling).

The test has been performed according to INFN test sequence AD2 and procedure AD1.

Details of test setup and results are contained in ANNEX 1 (SERMS facility test report).

Test conclusions and comments are summarized in chp 16.

2. DOCUMENTS

2.1 APPLICABLE DOCUMENTS

AD #	Doc Number	Issue	Date	Rev	Title
AD 1	AMS02-PR-CGS-004	1	Aug 2007		U-TOF vibration test procedure
AD 2	INFN document	1	Aug 2007		U-TOF vibration test sequence

2.2 REFERENCE DOCUMENTS

#	Doc Number	Issue	Date	Rev	Title
RD 1	RICSYS-RP-CGS-013_ls1	1	29-06-04		UPPER TOF STRUCTURAL ANALYSIS REPORT
RD 2	AMS02-TN-CGS-021	1	Aug 2007		UPPER TOF VIBRATION TEST PREDICTION
RD 3	JSC 28792		August 2003	Rev. C	Alpha Magnetic Spectrometer – 02 Structural Verification Plan for the Space Transportation System and the International Space Station

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3. ACRONYMS

C.I.	Configuration Item. Also called Part Number (P/N)
CGS	Carlo Gavazzi Space
CP	Control Point
ICD	Interface Control Drawing
FEM	Finite Element Method/Model
MP	Measurement Point
NA	Not Applicable
NCR	Non Conformance Report
P/N	Part Number. Also called Configuration Item C.I.
PA	Product Assurance
PVS	Procedure Variation Sheet
PSD	Power Spectral Density
QA	Quality Assurance
RV	Random Vibration
S/N	Serial Number
UUT	Unit Under Test
TOF	Time Of Flight
UTOF	Upper Time Of Flight

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4. TEST PARTICIPANTS AND RESPONSABILITIES

The test has been attended by :

NAME	COMPANY\INSTITUTE	ROLE	RESPONSABILITY
G. Laurenti	INFN	Test conductor	<ul style="list-style-type: none"> - UUT transportation and integration - Support to Facility manager for integration of UUT on fixture - Test conduction - Compilation of Step by step procedure - PA\QA management
R. Pilastrini C. Guandalini	INFN	Test Engineer	<ul style="list-style-type: none"> - Support to test conductor
A. Bursi	CGS	Test Engineer	<ul style="list-style-type: none"> - Support to test conductor for: <ul style="list-style-type: none"> o Instrumentation plan evaluation o vibration control quality evaluation o measurements evaluation and comparison to predictions.
A. Alvino	SERMS	Facility test manager	Facility management and interface to Test Conductor
S. Lucidi	SERMS	Facility QA Manager	<ul style="list-style-type: none"> - UUT instrumentation - Provision of test results
S. Borsini	SERMS	Facility Test Engineer	<ul style="list-style-type: none"> - UUT instrumentation - Facility equipment utilization and test execution - Provision of test results

Tab. 4-1 U TOF vibration test participants and responsibility.

5. TEST SCHEDULE

DATE	ACTIVITY DESCRIPTION	REMARKS
11/09/2007	UTOF internal accelerometers installation	
12-13/09/2007	XY Fixture characterization	
13-14/09/2007	Z Fixture characterization	
17-18/09/2007	UTOF preparation, internal and external accelerometers installation	
18/09/2007	Installation of Z setup on shaker and connection to DAS	
19/09/2007	Z axis test	
20/09/2007	Installation of X setup on shaker and connection to DAS	
21/09/2007	X axis test	
21/09/2007	Installation of setup on shaker, connection to DAS and Y axis test	

Tab. 5-1 U TOF vibration test schedule

6. NON CONFORMANCE AND FAILURES

No malfunction/defect has been occurred during the test.

7. CALIBRATION REQUIREMENTS

All instruments used for testing are calibrated.

Evidence of certification is provided in ANNEX 1.

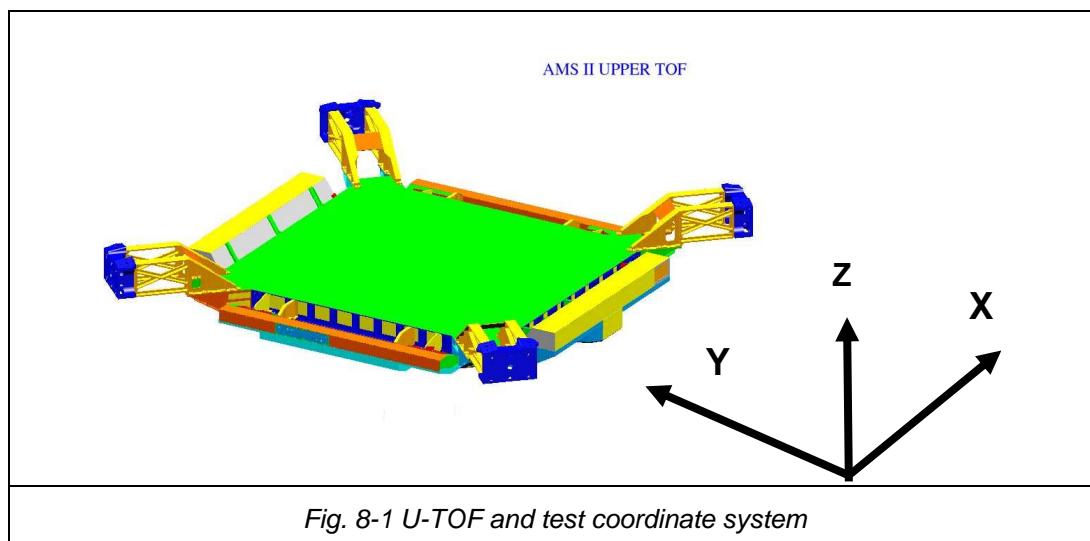
8. TEST ARTICLE

The test article consists of the UTOF assy. The following table shall be compiled during test:

MODEL	ITEM	C.I.	Part number	S/N	NOTES
FM	AMS UPPER TOF FM		AMS TOF UT	na	

The UTOF shall be tested without external harness during vibration.

Following figure shows the UUT in test configuration and the test reference coordinate system.



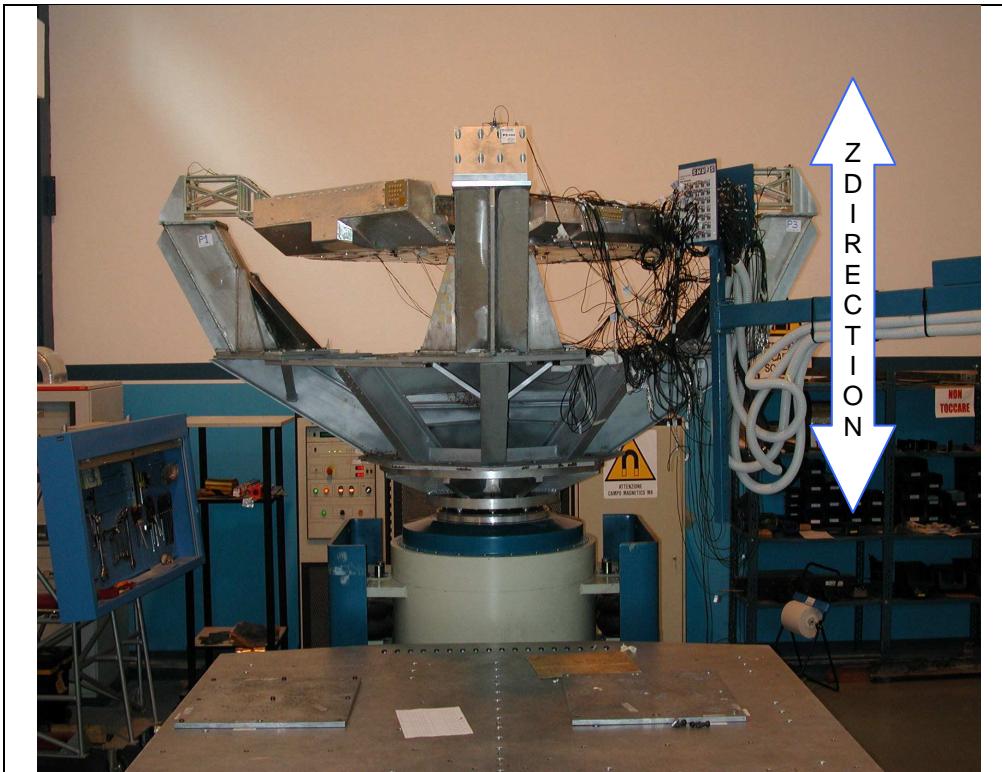


Fig. 8-2 U TOF picture Z axis

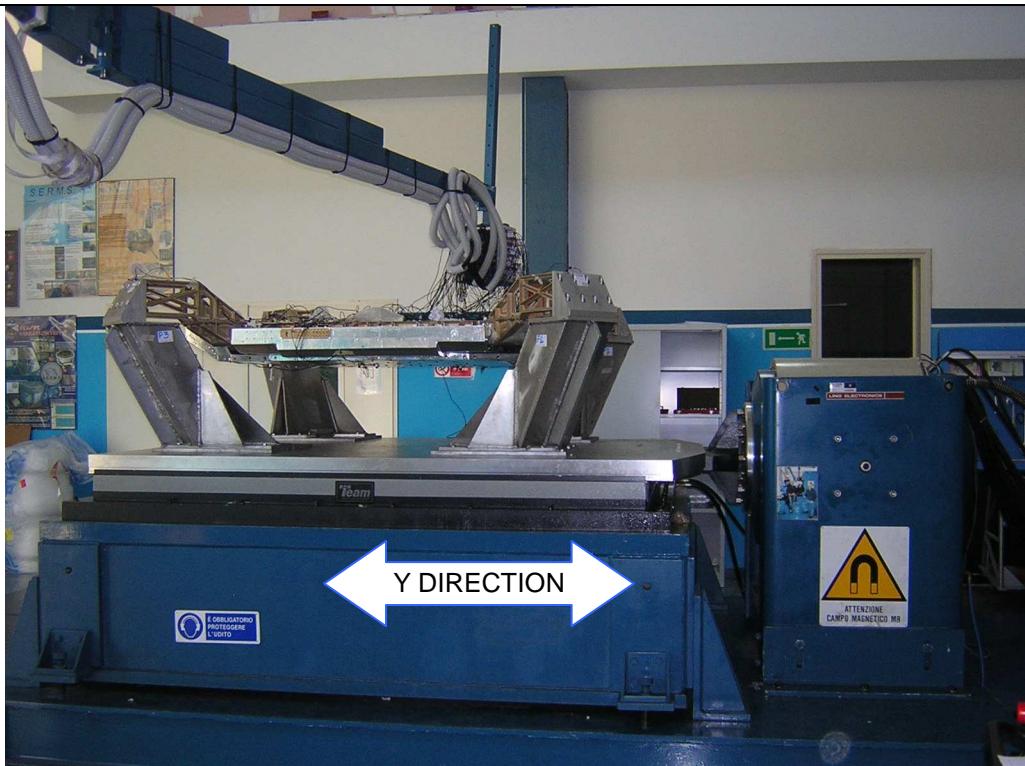


Fig. 8-3 U TOF picture Y axis



Fig. 8-4 U TOF picture X axis

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9. MEASUREMENT ACCURACY

Test parameter tolerances were the following:

Resonance search.

sweep rate = 2 oct/min $\pm 5\%$. (1 sweep-up and down), amplitude g

High level sine vibration.

frequency: $\pm 2\%$

excitation acceleration: $\pm 0.3g$

Random vibration.

frequency: $\pm 2\%$

power spectral density:

- | | |
|---|--------------|
| - 20 to 500 Hz (filter bandwidth 25 Hz or narrower) | ± 1.5 dB |
| - 500 to 2000 Hz | ± 3.0 dB |
| - Overall g_{RMS} | ± 1.5 dB |

10. CONTROL TOLERANCE

The transmissibility characteristic of the rigid fixture and the number of control channels used has guaranteed that the controlled input vibration level is transmitted from the exciter to the unit interface without relevant amplification/degradation (less than 3dB between 5 and 500 Hz and ± 6 dB between 500 and 2000 dB Provided that the cumulative bandwidth that exceeds ± 3 dB, does not exceed 300 Hz) with respect to the nominal input.

No relevant discrepancies between the control signal and the different control points occurred (multi-point control).

Cross talks have not exceed the input.

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11.REQUIREMENTS\SUCCESS CRITERIA CROSS REFERENCE

Cross reference among requirements and procedure steps is provided in Tab. 11-1. .

REQ. n°	REQUIREMENT	SUCCESS CRITERION	RESONANCE SEARCH	RANDOM LOW LEVEL	RANDOM FULL LEVEL	RESONANCE SEARCH
UTOF-RVT 0	FEM model of the fixture well correlated with the fixture calibration test results.		X			
UTOF-RVT 1	-Upper TOF First Mode > 33.62 Hz (Current Predicted Mode FIXTURE MOUNTED = 33.62 Hz ,First mode is a drum mode Current Predicted Mode HARD MOUNTED = 43.95 Hz ,First mode is a drum mode	F1> 33.62 Hz	X			X
UTOF-RVT 2	- Upper TOF Optional Verification for mission success (Random Vibration to MEFL UUT not degraded by applicable qualification random environment	No discrepancy on plots, no damage, loose parts or yielding		X	X	
		No frequency shift >5%, no amplitude variation >30%				X

Tab. 11-1 Requirements cross reference

11.1 FIXTURE TEST RESULTS

A resonance search was performed using the sine input in order to characterized both Fixture Z and Fixture XY behavior.

The sine input used is shown in the following table

Linear frequency scan band:	5-2000 Hz
Scan speed	2 oct/min (sweep up only)
Level:	0.3 g (peak)
Control:	Multipoint input control is used with maximum strategy.

Tab. 11-2 Sine input used for fixture test

Z-DIRECTION FIXTURE UNLOADED RESONANCE SEARCH (FIXTURE CALIBRATION)

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The following figure shows the tested configuration and the FEM node output compared with the results. The Measurement Points (MP) have been divided considering the Column (COL) numeration. The four columns outputs are compared to the single node FEA result since the finite elements analysis provides symmetric results, while the four columns are slightly different each other.

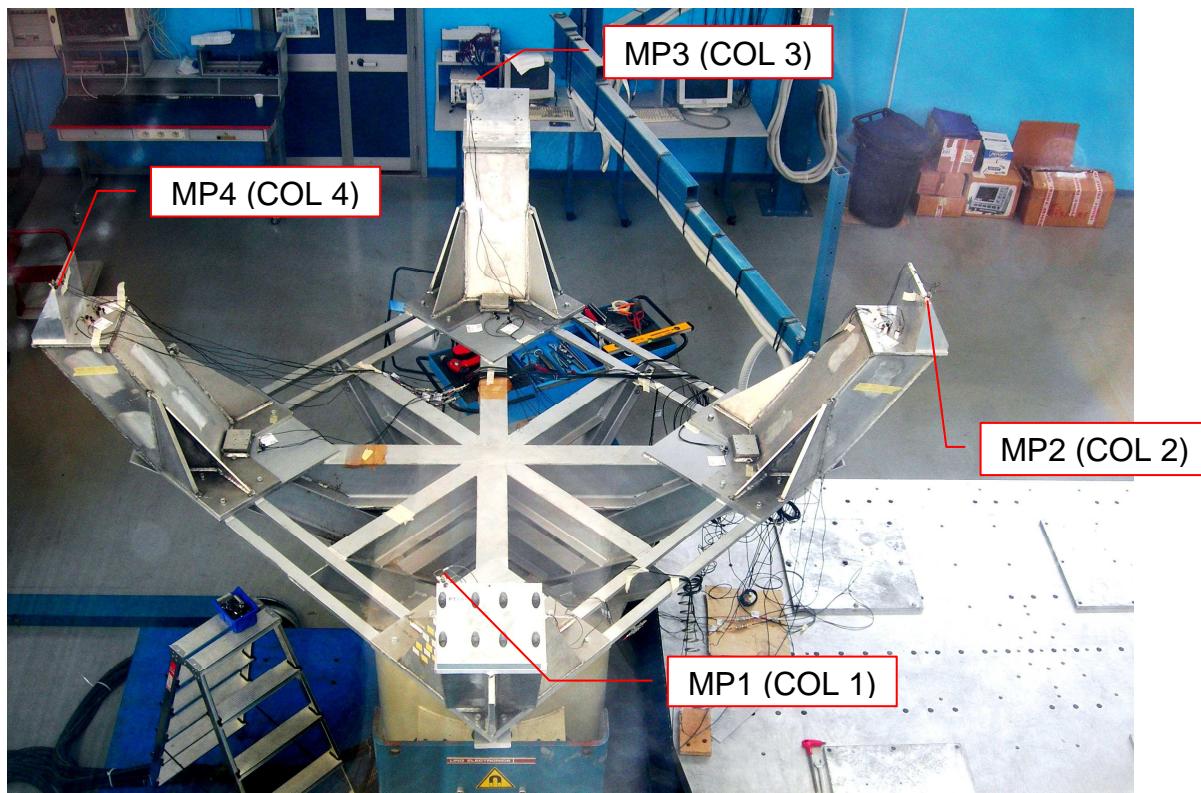


Figure 11-1 Fixture Z test configuration

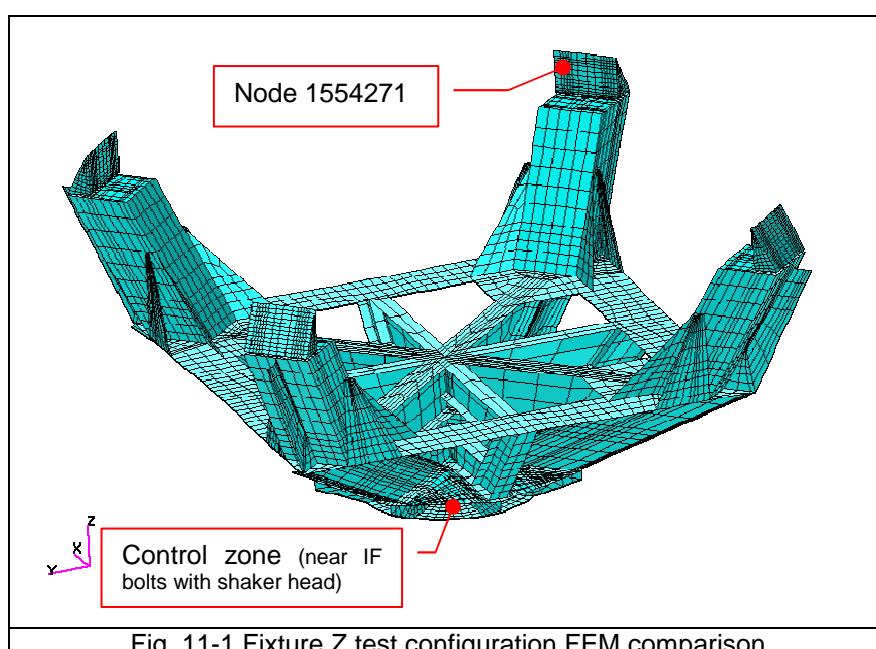


Fig. 11-1 Fixture Z test configuration FEM comparison

The following figure shows the FEA results

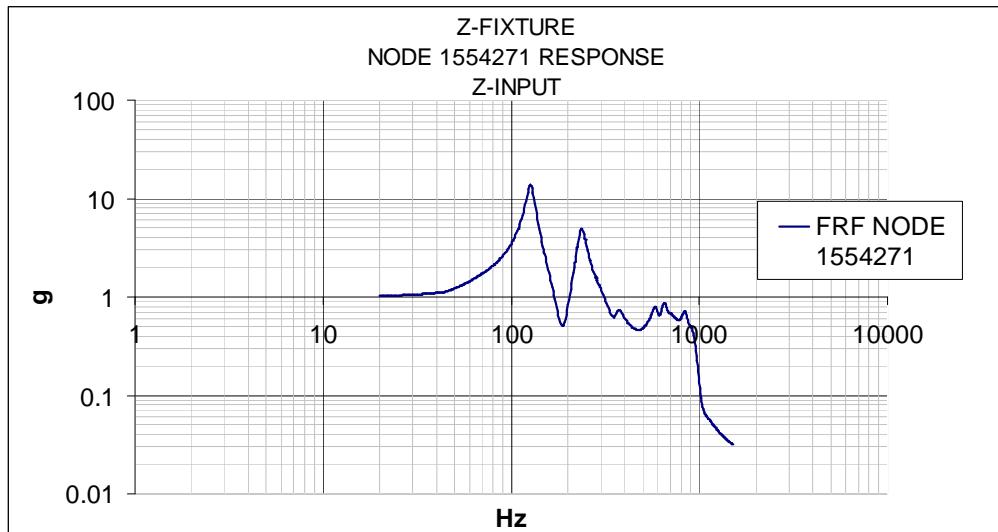


Fig. 11-2 NODE 1554271 response considering Fixture Z - Z-Input

The following figures show the obtained results by test.

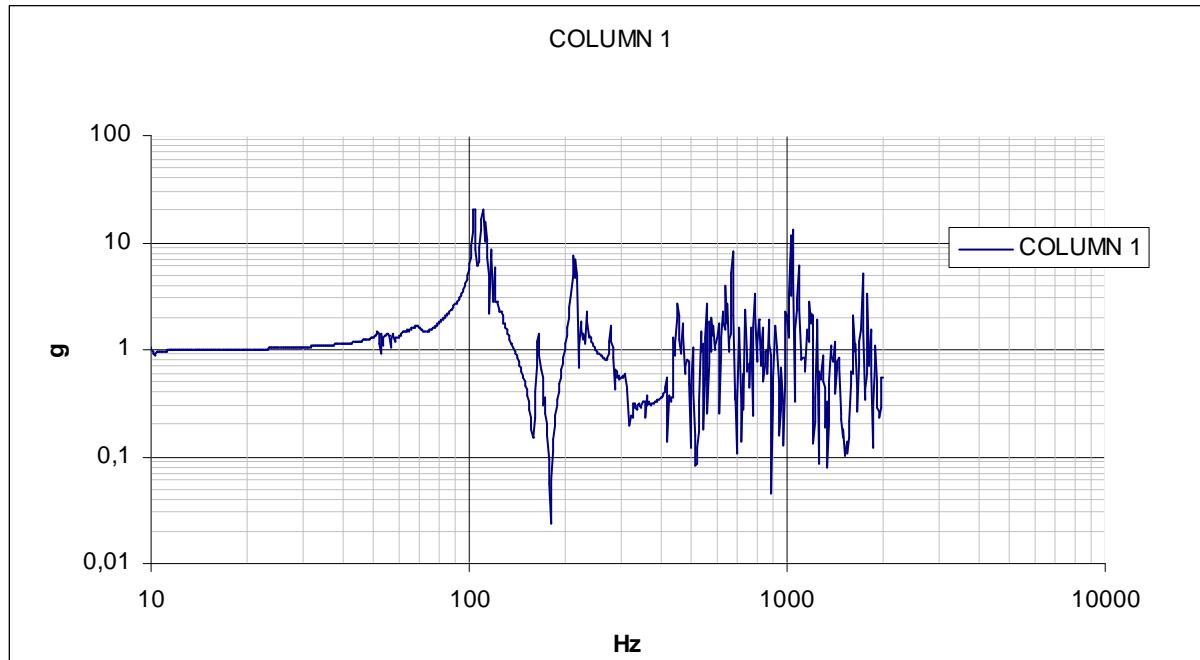


Figure 11-2 Column 1 upper point response in Z-Direction

COLUMN2

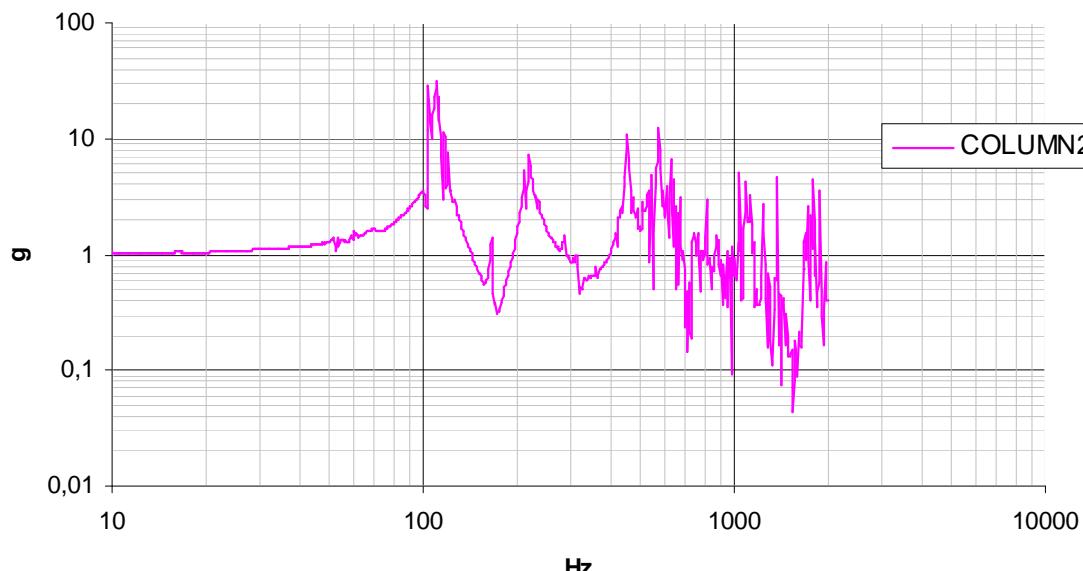


Figure 11-3 Column 2 upper point response in Z-Direction

COLUMN 3

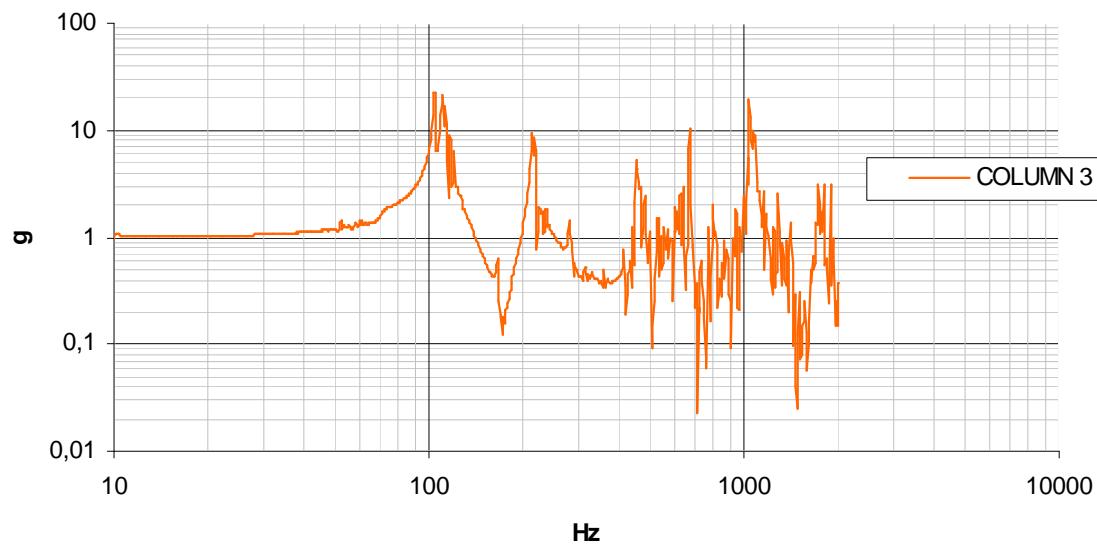


Figure 11-4 Column 3 upper point response in Z-Direction

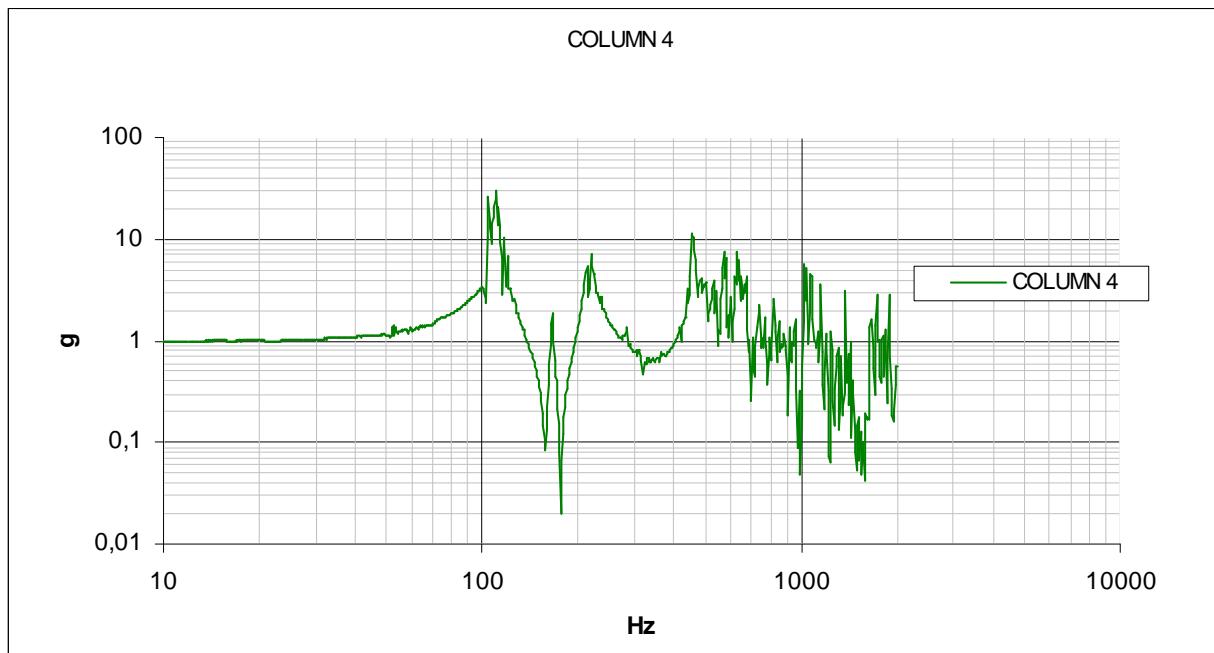


Figure 11-5 Column 4 upper point response in Z-Direction

The following table summarizes the obtained frequencies.

Name	First Freq. [Hz]	Amplitude 1	Second Freq. [Hz]	Amplitude 2
Prediction (All Columns)	126	12.6	238	4.85
Test Column 1	111	20.3	216	6.9
Test Column 2	111	31.6	219	7.4
Test Column 3	111	21.8	216	8.5
Test Column 4	111	29.5	220	5.5

Table 11-1 Frequencies and amplitudes comparison of Fixture Z predicted value and Fixture Z test results

The test results are near the FEA results; the maximum first frequency difference is -13%; the frequency shift is below the 20% therefore the prediction for the U-TOF fixture mounted (RD2) are considered acceptable. For this reason the first frequency requirement of the UTOF fixture mounted is confirmed (see RD2) $F_1 > 33.62$ Hz.

The amplifications are higher than the predicted ones; however the controller is able to compensate this variation and to guarantee the corrected input (on all points) for the random vibration test of UTOF.

The column 2 output has more damping than prediction; this has been taken into account by the control system during the UTOF vibration test.

In addition a test has been performed in order to evaluate the controller capability to work on four points on column top.

The control performances in terms of tolerance ,uniformity and cross talks are acceptable considering the UUT expected first frequency.

- CONTROL TOLERANCES: The controlled input is not within the required ± 3 dB in the 100-500 Hz range, excess of ± 6 dB is detected in the 500-750 Hz range.

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- CONTROL UNIFORMITY: Uniformity of the 4 control points is good only up to 100 Hz. The lower control point in the 100-200 Hz range are more or less -6dB lower than the upper ones due to fixture dynamics.
- CONTROLLED RANGE: resonance search run with maximum control on 4 points (CP1 to CP4) has been performed in the 5-2000 Hz range.

XY-DIRECTION FIXTURE UNLOADED RESONANCE SEARCH (FIXTURE CALIBRATION)

The fixture calibration was performed in Y direction as explained in the PVS 1.

The following figure shows the tested configuration and the FEM node output compared with the results.

The Measurement Points (MP) have been divided considering the Column (COL) numeration.

The four columns outputs are compared to the single node FEA result since the finite elements analysis provides symmetric results, while the four columns are slightly different each other.

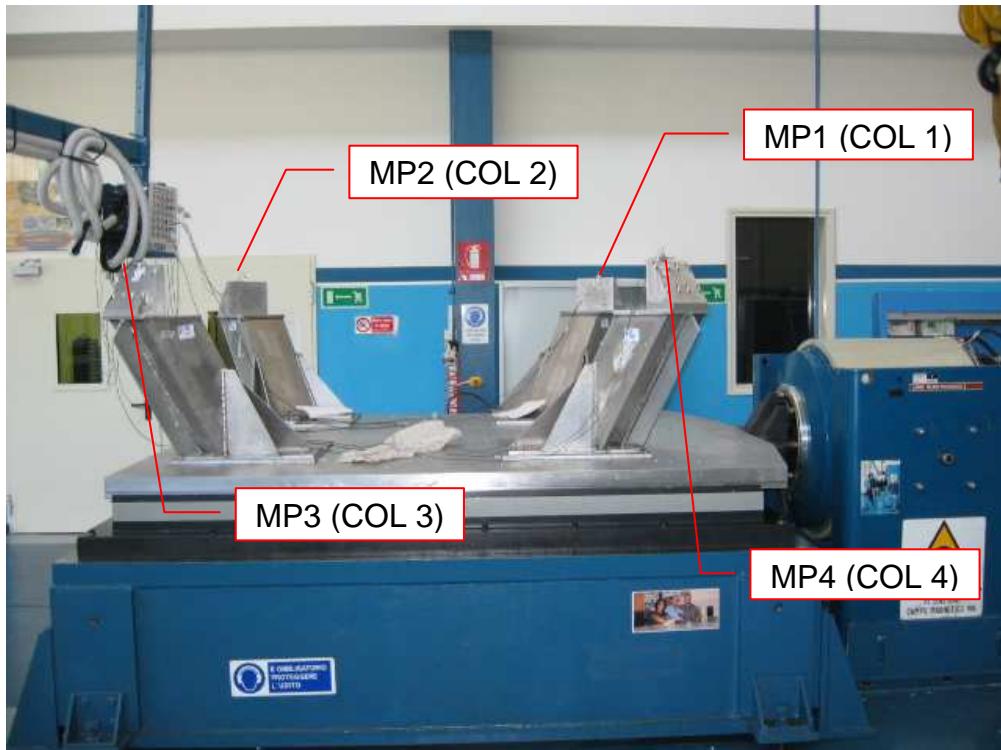


Figure 11-6 Fixture XY test configuration Y direction

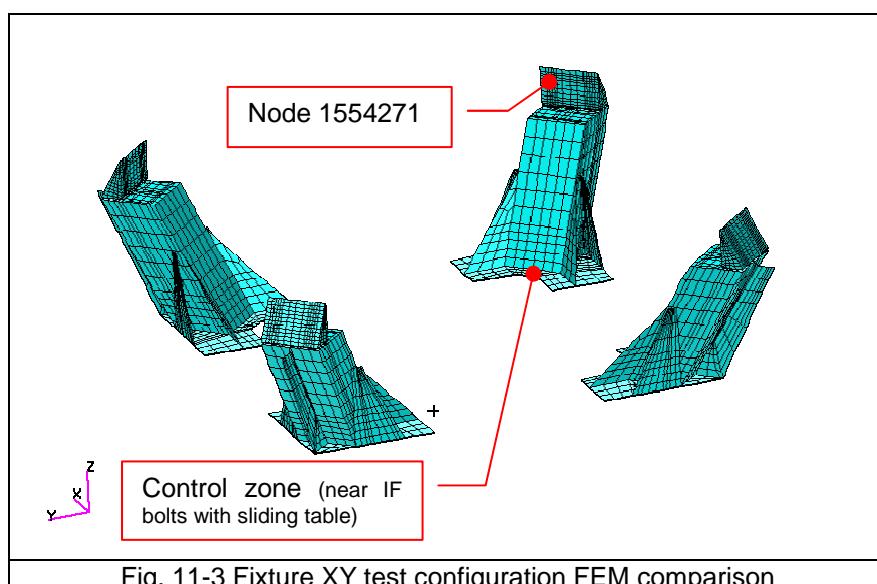


Fig. 11-3 Fixture XY test configuration FEM comparison

The following figures shows the FEA result.

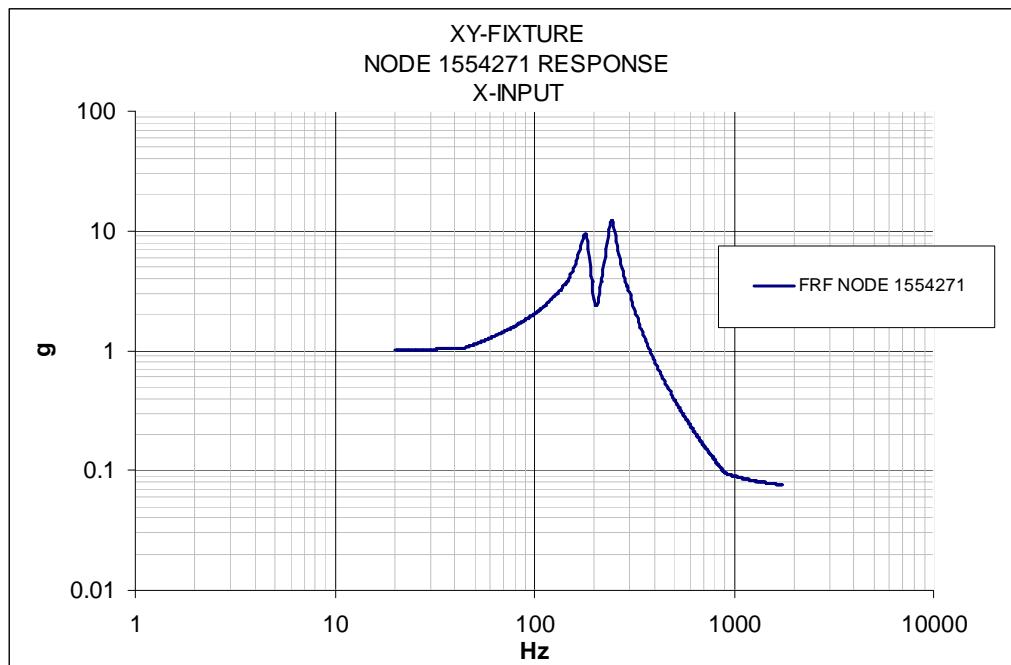


Fig. 11-4 NODE 1554271 response considering Fixture XY - Y-Input

The following figures shows the obtained results by test:

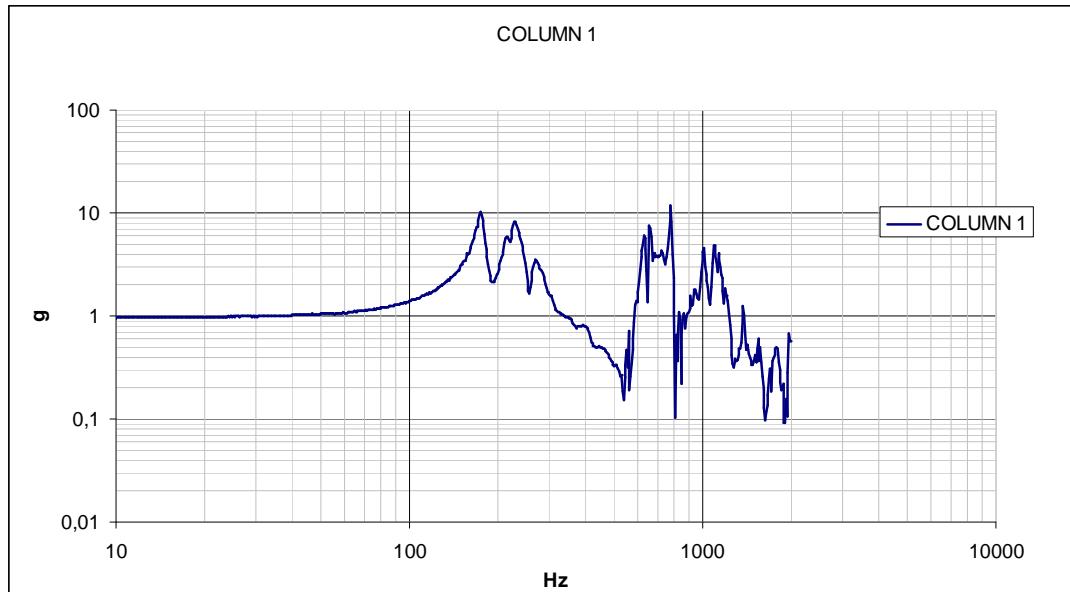


Figure 11-7 Column 1 upper point response in X-Direction

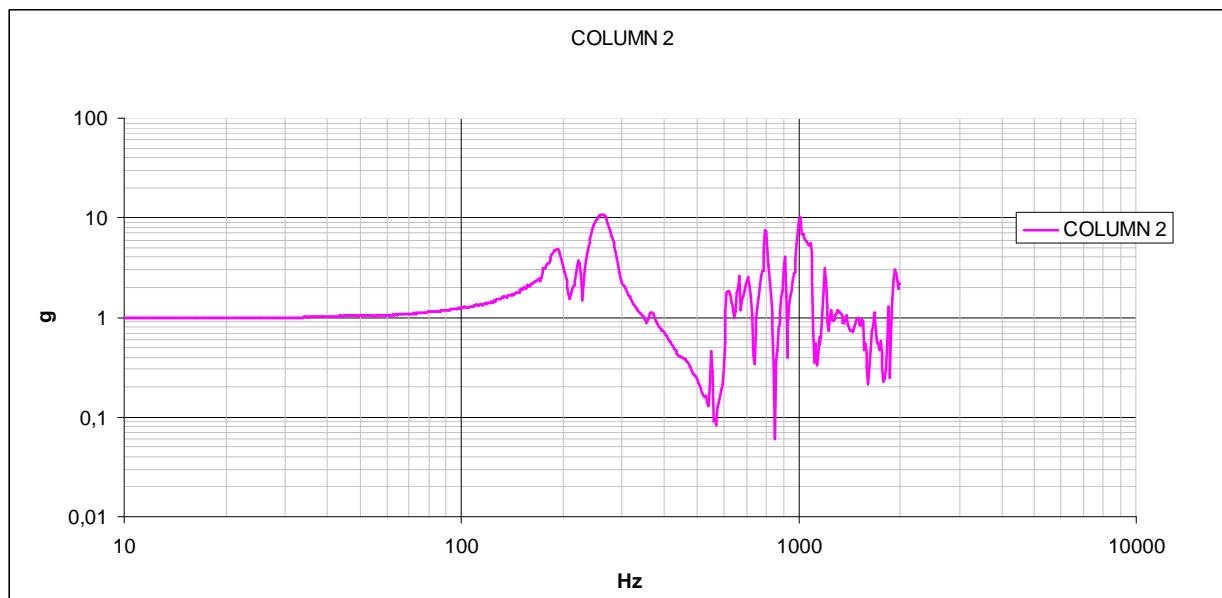


Figure 11-8 Column 2 upper point response in X-Direction

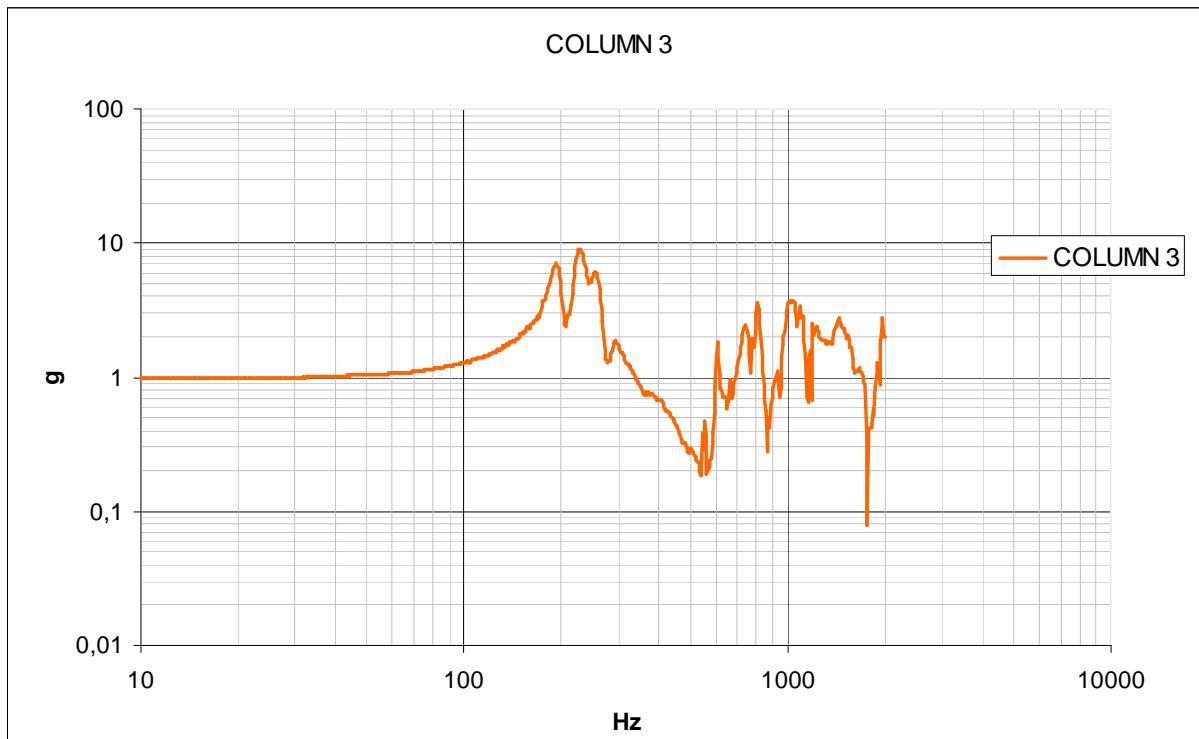


Figure 11-9 Column 3 upper point response in X-Direction

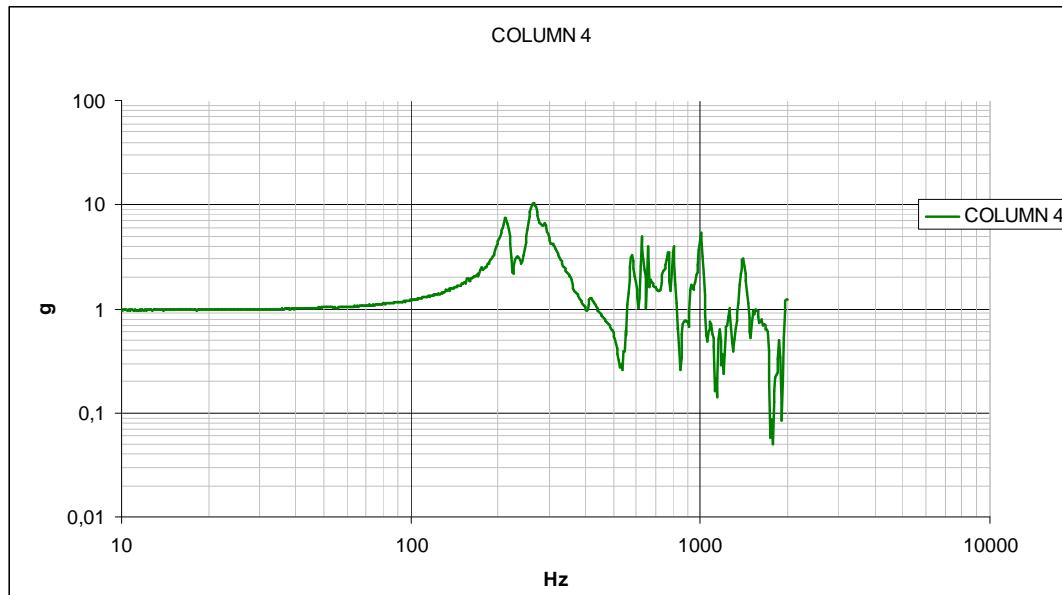


Figure 11-10 Column 4 upper point response in X-Direction

The test highlights a similar behavior of columns with two main peaks and noise at high frequencies, the following table summarizes the obtained frequencies from prediction and from test..

Name	First Freq. [Hz]	Amplitude 1	Second Freq. [Hz]	Amplitude 2
Prediction (All Columns)	181	9.34	246	11.68
Test Column 1	175	10.2	229	8.1
Test Column 2	192	4.8	262	10.7
Test Column 3	193	7	227	9
Test Column 4	214	7	268	9.9

Table 11- Frequencies and amplitudes comparison of Fixture Z predicted value and Fixture XY test results

The test results are near the FEA results; the maximum first frequency difference is +15% therefore the columns are at least stiffer than prediction. For this reason the first frequency requirement of the UTOF fixture mounted is confirmed (see RD2) $F_1 > 33.62$ Hz.

The column 2 output has more damping than prediction; this has been taken into account by the control system during the UTOF vibration test.

In addition a test has been performed in order to evaluate the controller capability to work on four points on column top.

The control performances in terms of tolerance ,uniformity and cross talks are acceptable considering the UUT expected first frequency.

- CONTROL TOLERANCES: The controlled input is not within the required ± 3 dB in the 100-500 Hz range, excess of ± 6 dB is detected in the 500-750 Hz range.
- CONTROL UNIFORMITY: Uniformity of the 4 control points is good only up to 100 Hz. The lower control point in the 100-200 Hz range are more or less -6dB lower than the upper ones due to fixture dynamics.
- CONTROLLED RANGE: resonance search run with maximum control on 4 points (CP1 to CP4) has been performed in the 5-2000 Hz range.

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12. INSTRUMENTATION, SPECIAL TOOLS AND TEST EQUIPMENT

The complete list of the instrumentation used during the test shall be recorded in Tab. 12-1.

The list shall be filled up during tests and reported in Test Report.

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13.USED TEST LEVELS

13.1 RESONANCE SEARCH LEVELS

During resonance search the following level were used for sine input:

Linear frequency scan band:	5-2000 Hz
Scan speed	2 oct/min (sweep up only)
Level:	0.3 g (peak)
Control:	Multipoint input control is used with maximum strategy.

Tab. 13-1 Resonance search level (sine input)

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13.2 RANDOM VIBRATION LEVELS

No notching was required for X and Y MEFL levels. The notching was applied to the Z direction as explained in the PVS 4. The X-Y MEFL (from AD1 – RD3) and the Notched Z Random spectra reported hereafter

JSC 28792, Rev. C				
Table 15-1: Maximum Expected Flight Levels for AMS-02				
X Axis	20-58 Hz	0.0025 g ² /Hz		
	58-125 Hz	+9 dB/Octave		
	125-300 Hz	0.025 g ² /Hz		
	300-900 Hz	-9 dB/Octave		
	900-2000 Hz	0.001 g ² /Hz		
	Overall = 3.1 Grms			
Y Axis	20-80 Hz	0.008 g ² /Hz		
	90-100 Hz	+9 dB/Octave		
	100-300 Hz	0.01 g ² /Hz		
	300-650 Hz	-9 dB/Octave		
	650-2000 Hz	0.001 g ² /Hz		
	Overall = 2.3 Grms			
<i>MEFL test duration: 60 seconds</i>				
Tab. 13-2 LTOF MEFL Random spectrum FROM AD1				

Z - DIRECTION FULL LEVEL	
Freq [Hz]	PSD [g ² /Hz]
20	0.009
45	0.009
125	0.025
180	0.025
200	0.0161
320	0.0161
900	0.001
2000	0.001
Total	2.99 gRMS
Duration	60 sec

Tab. 13-3 LTOF MEFL Random spectrum FROM AD1

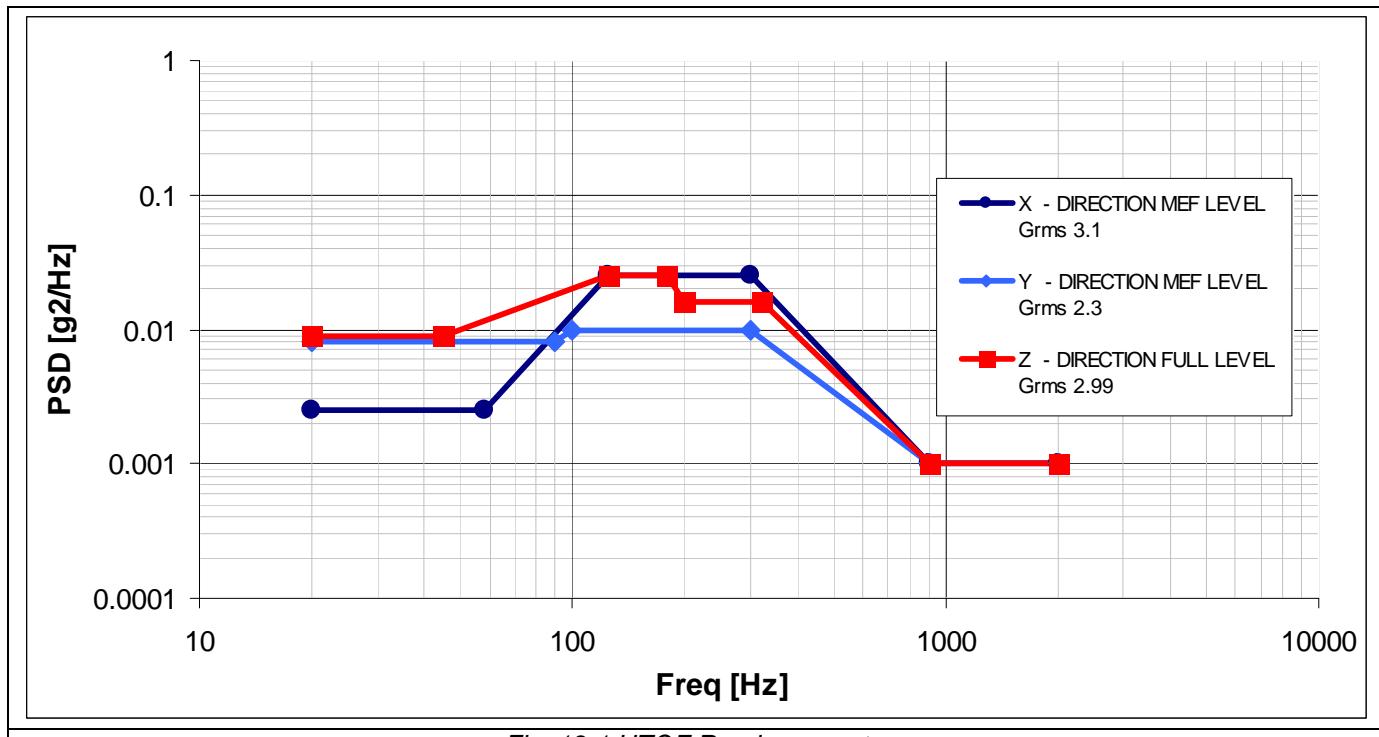


Fig. 13-1 UTOF Random spectra

 INFN <small>Istituto Nazionale di Fisica Nucleare</small> SEZIONE DI BOLOGNA	AMS-02-TOF <hr/> L-TOF VIBRATION TEST REPORT	N° Doc: <i>Doc N°:</i> Ediz.: <i>Issue:</i> Pagina <i>Page</i>	1 Data: <i>Date:</i> OCT 2007
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14. TEST CONDITIONS

- Unless otherwise specified, all the measurements are to be performed at the following ambient conditions:
 - Temperature : $20\text{C} \pm 5\text{C}$
 - Relative humidity : $60\% \pm 20\% \text{ RH}$
 - Pressure : Ambient
 - Cleanliness : visibly clean class
- During vibration on shaker it shall be considered acceptable to reach the following conditions
 - Temperature : $30\text{C} \pm 8\text{C}$
 - Relative humidity : $60\% \pm 30\% \text{ RH}$
 - Pressure : Ambient
 - Cleanliness : implementation of means to reduce contamination of the unit in a non visibly clean environment

15. TEST PROCEDURE VARIATION SHEET

The 6 performed PVS are collected here follow.

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15.1 PVS 1

PROCEDURE VARIATION SHEET ref. N°1 (page 1 of 1)		
Test Procedure Ref.: UTOF vibration test sequence	Page Revised: Pg. 12-13	Paragraph Revised: Par. 10.1
Description of Change: Unloaded fixture resonance search axis change Unloaded fixture resonance search was performed for the Y direction instead of X direction.		
Reason for Change: The fixture test setup prepared by SERMS was for the Y direction. Since the X and Y behaviors of the XY fixture are equal, in order to save time, the Y axis resonance search was performed.		
CONCURRENCE		
Test Cond G. Laurenti.	QA	System Eng.
Date 12/09/07	Date	Date

15.2 PVS 2

PROCEDURE VARIATION SHEET ref. N°2 (page 1 of 2)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
AMS02-PR-CGS-004 UTOF vibration test procedure	Pg. 23-25	Par. 15.1

Description of Change: Modified instrumentation plan
 The position of some sensors internal to the UTOF have been slightly modified to guarantee better measurements.
 The details of the used instrumentation plan are defined in the test report

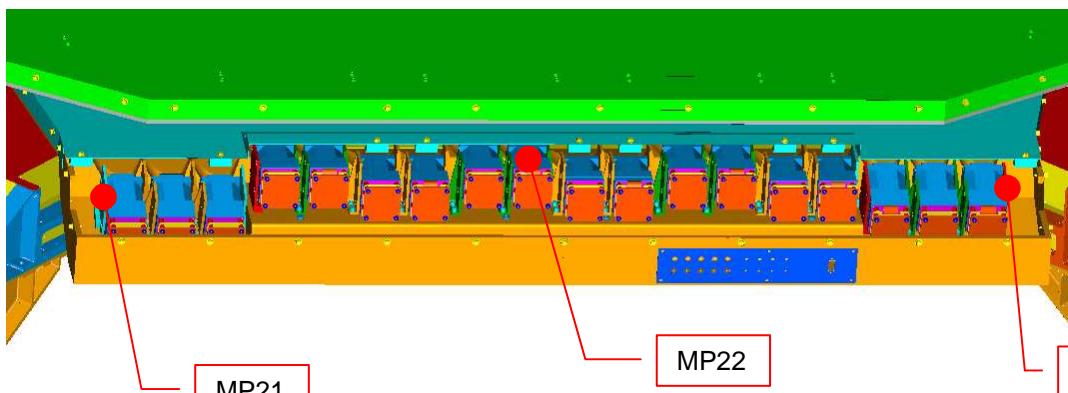


Fig. 15-1 U-TOF qualification internal measurement points view

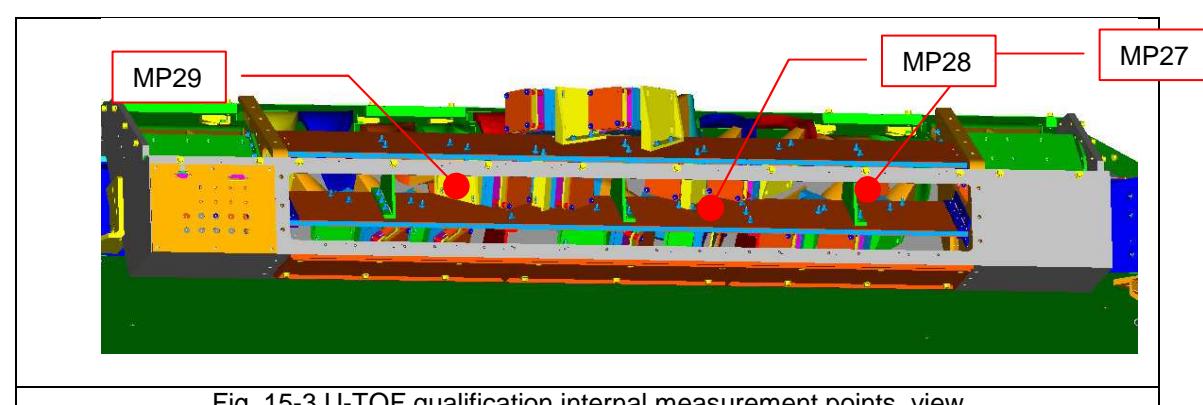
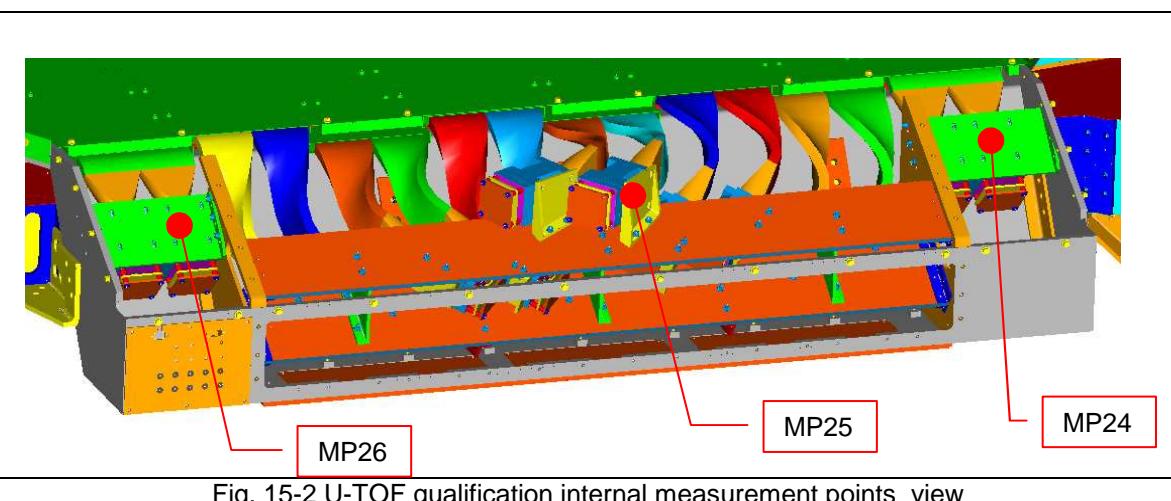
CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 12/09/07	Date	Date		Date

PROCEDURE VARIATION SHEET ref. N°2 (page 2 of 2)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
AMS02-PR-CGS-004 UTOF vibration test procedure	Pg. 23-25	Par. 15.1

Description of Change: Modified instrumentation plan



Reason for Change:

Improvement of the instrumentation plan measurement performance after hardware physical status evaluation. The accelerometer definitive position was determined in order to maximize the measurement capability in the UTOF accessible internal envelope.

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
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15.3 PVS 3

PROCEDURE VARIATION SHEET ref. N°3 (page 1 of 3)						
Test Procedure Ref.:		Page Revised:		Paragraph Revised:		
UTOF vibration test sequence						
Description of Change:						
Added random vibration test -9 dB and -3 dB for X, Y and Z vibration axes.						
STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS		
2.2.1 B1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-9dB)	OK	OK			
2.2.1 B2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected			
2.2.1 B3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	The full level extrapolation confirms that the g _{RMS} values respect the limits. No notching is required.		
2.2.1 C1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-3dB)	OK	OK			
2.2.1 C2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected			
2.2.1 C3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	The full level extrapolation confirms that the g _{RMS} values respect the limits. No notching is required.		
CONCURRENCE						
Test Cond G. Laurenti.	QA	System Eng.		Customer		
Date 19/09/07	Date	Date		Date		

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PROCEDURE VARIATION SHEET ref. N°3 (page 2 of 3)

Test Procedure Ref.:		Page Revised:	Paragraph Revised:			
UTOF vibration test sequence		Pg. 26 Pg. 31 Pg. 35	Par. 16.1			
Description of Change:						
Added random vibration test -9 dB and -3 dB for X, Y and Z vibration axes.						
STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS		
3.2.1 B1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-9dB)	OK	OK			
3.2.1 B2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected			
3.2.1 B3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	The full level extrapolation confirms that the g _{RMS} values respect the limits. No notching is required.		
3.2.1 C1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-3dB)	OK	OK			
3.2.1 C2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected			
3.2.1 C3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	The full level extrapolation confirms that the g _{RMS} values respect the limits. No notching is required.		
CONCURRENCE						
Test Cond G. Laurenti.	QA	System Eng.		Customer		
Date 19/09/07	Date	Date		Date		

 INFN <small>Istituto Nazionale di Fisica Nucleare</small> SEZIONE DI BOLOGNA	<h1>AMS-02-TOF</h1>	N° Doc: <i>Doc N°:</i> Ediz.: <i>Issue:</i> Pagina <i>Page</i>	1 Data: <i>Date:</i> OCT 2007
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PROCEDURE VARIATION SHEET ref. N°3 (page 3 of 3)

Test Procedure Ref.: UTOF vibration test sequence	Page Revised: Pg. 26 Pg. 31 Pg. 35	Paragraph Revised: Par. 16.1
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Description of Change:

Added random vibration test -9 dB and -3 dB for X, Y and Z vibration axes.

STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS
4.2.1 B1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-9dB)	OK	OK	
4.2.1 B2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected	
4.2.1 B3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	The full level extrapolation shows that the g _{RMS} values are higher than the limits. Notching is required.
4.2.1 C1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-3dB)	OK	OK	
4.2.1 C2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected	
4.2.1 C3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	No differences from the other low level runs; notching is confirmed.

Reason for Change:

Two random vibration low levels have been added in order to well characterize the UTOF behavior from the PMT acceleration level point of view. In particular using this vibration level steps a not-linear response shall be eventually identified.

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 19/09/07	Date	Date		Date

 INFN <small>Istituto Nazionale di Fisica Nucleare</small> SEZIONE DI BOLOGNA	<h1>AMS-02-TOF</h1>	N° Doc: <i>Doc N°:</i> Ediz.: <i>Issue:</i> Pagina <i>Page</i>	1	Data: <i>Date:</i> OCT 2007
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15.4 PVS 4

PROCEDURE VARIATION SHEET ref. N°.4 (page 1 of 6)

Test Procedure Ref.: UTOF vibration test sequence	Page Revised: Pg. 17	Paragraph Revised: Par. 12.2
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Description of Change: Z vibration level has been notched.
The Random Vibration level in Z direction has been notched as shown in the following tables and figures.

Z - DIRECTION MEFL		Z - DIRECTION NOTCHED LEVEL	
Freq [Hz]	PSD [g ² /Hz]	Freq [Hz]	PSD [g ² /Hz]
20	0.009	20	0.009
45	0.009	45	0.009
125	0.025	125	0.025
300	0.025	180	0.025
900	0.001	200	0.0161
2000	0.001	320	0.0161
Total	3.2 gRMS	900	0.001
Duration	60 sec	2000	0.001
		Total	2.99 gRMS
		Duration	60 sec

Figure 15-1 Z direction vibration level MEFL on left and notched on right

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.	
Date 19/09/07	Date	Date	Date

PROCEDURE VARIATION SHEET ref. N°.4 (page 2 of 6)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
UTOF vibration test sequence	Pg. 17	Par. 12.2

Description of Change: Z vibration level has been notched.
 Cont'd

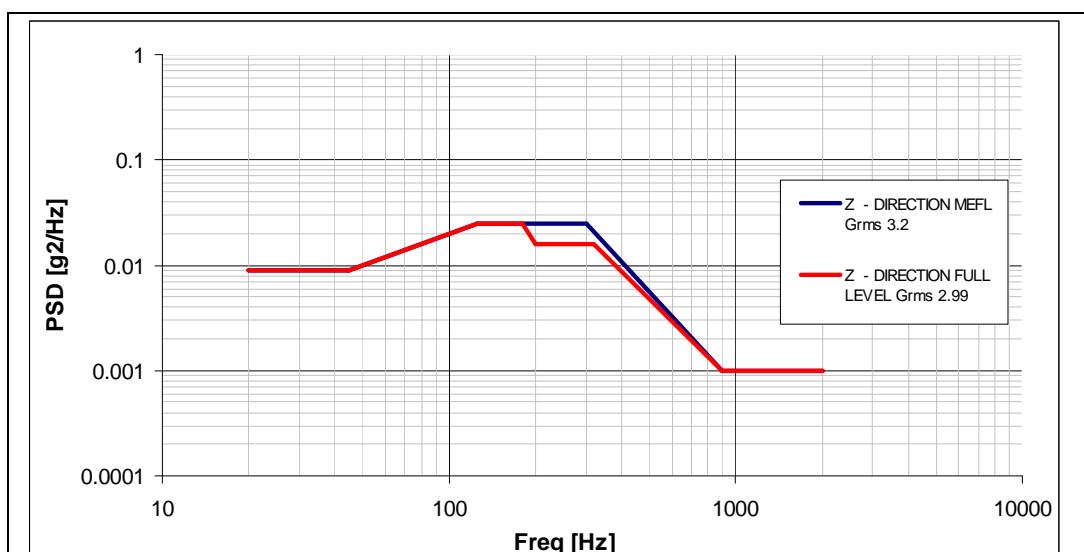


Figure 15-2 MEFL and notched Z direction vibration levels comparison

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 19/09/07	Date	Date		Date

PROCEDURE VARIATION SHEET ref. N°.4 (page 3 of 6)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
UTOF vibration test sequence	Pg. 17	Par. 12.2

Reason for Change:

The PMT acceleration level was monitored during the low level random vibration, as shown in the following table.

PMT	-9 dB	-6 dB	-3 dB
MP 21	2.94	4.10	6.09
MP 22	1.90	2.68	3.84
MP 23	2.55	3.50	5.18
MP 24	1.46	2.05	2.94
MP 25	1.96	2.68	3.99
MP 26	1.76	2.28	3.24
MP 27	2.23	2.91	N.A.
MP 28	1.78	2.44	3.56
MP 29	0.89	1.13	1.62

Table 15-1 Acceleration level measured on PMT during the Low level Random

The MP27 measurements in the -3dB test can't be used because one accelerometer placed on this PMT starts malfunctioning, as shown in the following figure.

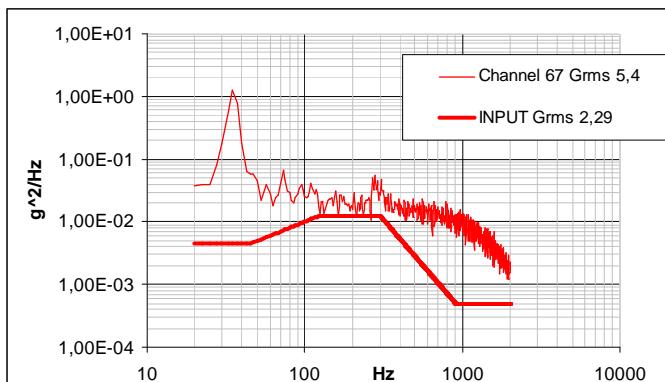


Figure 15-3 MP27 accelerometer channel malfunctioning evidence

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
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PROCEDURE VARIATION SHEET ref. N°4 (page 4 of 6)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
UTOF vibration test sequence	Pg. 17	Par. 12.2

Reason for Change:

Using the Table 15-1 data the full level prediction has been performed and the following table shows the obtained results.

PMT	FULL LEVEL PREDICTION
MP 21	8,61
MP 22	5,43
MP 23	7,32
MP 24	4,16
MP 25	5,64
MP 26	4,58
MP 27	5,82
MP 28	5,04
MP 29	2,30

Table 15-2 Full level prediction for the Z-direction random vibration test

The acceleration level exceeds for MP21 and MP23; in order to preserve the PMT a notched input has been considered.

The notching procedure has been implemented to preserve the PMT functionality and to maintain the structural meaning of the vibration test. In particular the CoG acceleration level was preserved. The MP10 was the CoG representative accelerometer, the following table shows the comparison between the prediction with the MEFL input and the measured output with the notched input in terms of Grms.

Accelerometer representative of CoG	Predicted Level without notching	Measured Level with notching	% Difference
MP 10	3.3	3	9%

Table 15-3 Full level prediction for the Z-direction random vibration test

The differences in terms of Grms and amplification are less than 10% therefore the structural representativeness of vibration test in Z direction has been preserved.

The following table shows the obtained PMT acceleration level and the following figures show the MP21 and MP23 obtained spectrum in Z direction.

CONCURRENCE				
Test Cond G. Laurenti.	QA	System Eng.		Customer
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PROCEDURE VARIATION SHEET ref. N°.4 (page 5 of 6)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
UTOF vibration test sequence	Pg. 17	Par. 12.2

Reason for Change:

PMT	FULL LEVEL RESULTS
MP 21	5,04
MP 22	3,63
MP 23	4,79
MP 24	3,54
MP 25	4,93
MP 26	3,20
MP 27	N.A.
MP 28	4,54
MP 29	1,79

Table 15-4 Full level measured acceleration for the Z-direction random vibration test

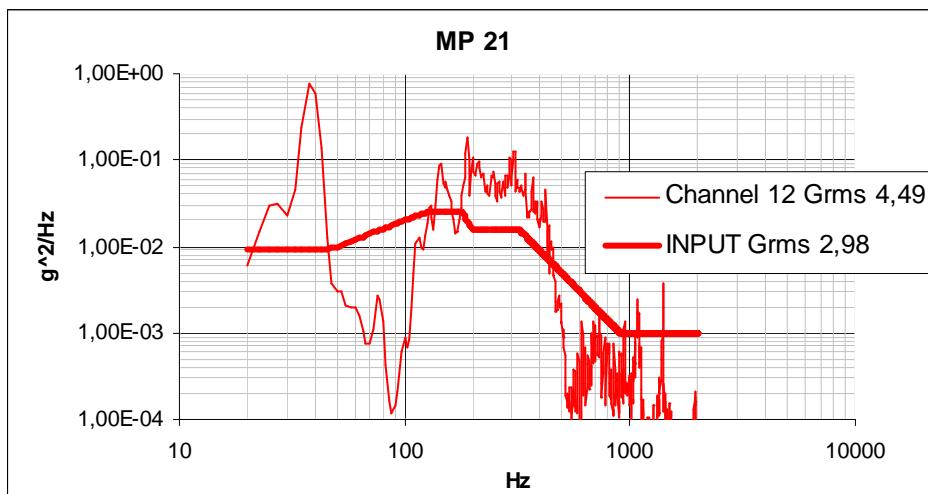


Figure 15-4 MP21 Z direction acceleration spectrum compared to the Z notched input

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
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 INFN Istituto Nazionale di Fisica Nucleare SEZIONE DI BOLOGNA	<h1>AMS-02-TOF</h1> L-TOF VIBRATION TEST REPORT	N° Doc: Doc N°: Ediz.: Issue: Pagina Page	1	Data: Date: OCT 2007
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PROCEDURE VARIATION SHEET ref. N°.4 (page 6 of 6)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
UTOF vibration test sequence	Pg. 17	Par. 12.2

Reason for Change:

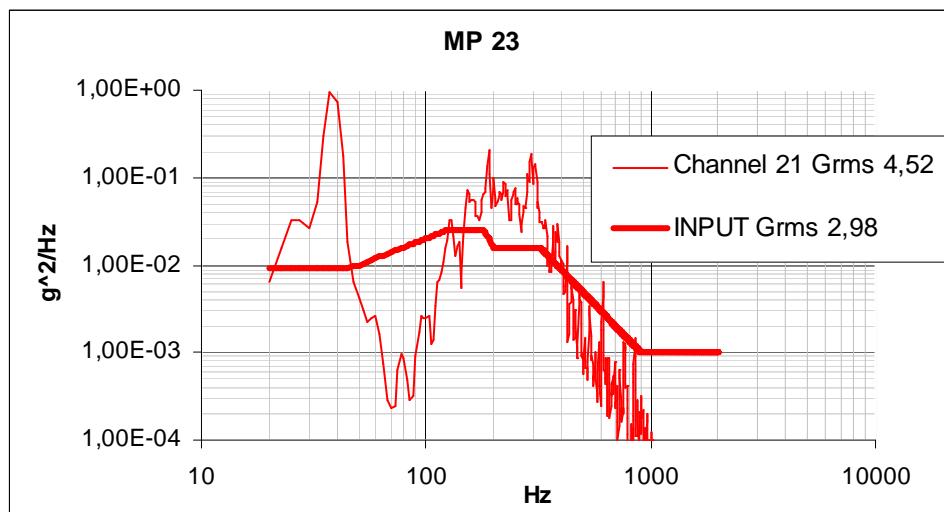


Figure 15-5 MP23 Z direction acceleration spectrum compared to the Z notched input

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 19/09/07	Date	Date		Date

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15.5 PVS 5

PROCEDURE VARIATION SHEET ref. N°5 (page 1 of 1)

Test Procedure Ref.: AMS02-PR-CGS-004 UTOF vibration test procedure	Page Revised: Pg. 23-25	Paragraph Revised: Par. 15.1
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Description of Change: Four accelerometers re-positioned after the Z direction vibration test
After the Z direction vibration test four accelerometers have been re-positioned:

- MP 27 (detached)
- MP 29 (detached)
- MP 20 (incipient detachment)
- MP 23 (noise on sensor)

The MP 27 and MP 29 re-positioning was based on PVS 2.

The MP20 has been moved from the original position and the new position is shown in the following figure.

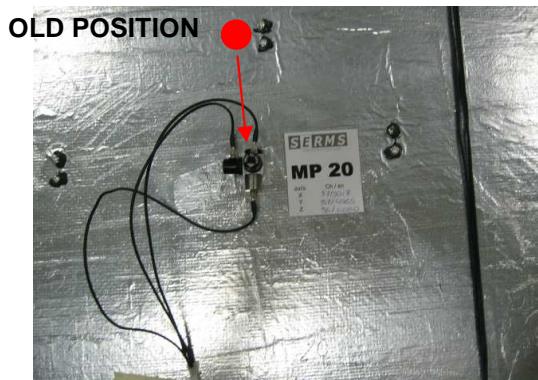


Figure 15-6 Position changing of MP20

The MP23 has been placed more internally with respect to the original position in order to avoid the contact of the accelerometer connector with the UTOF cover panel during the vibration.

Reason for Change

The sensors full functionality has been recovered for the X and Y vibration tests.

The out of work Measurement Points don't provide fundamental information about the test success, but only additional data. For this reason no additional resonance search after this operation was performed for the Z direction.

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 19/09/07	Date	Date		Date

15.6 PVS 6

PROCEDURE VARIATION SHEET ref. N°6 (page 1 of 3)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
-AMS02-PR-CGS-004 UTOF vibration test procedure	Pg. 21	Par. 15.1
-UTOF vibration test sequence	Pg. 28	Par. 16.1

Description of Change:

Shaker Control Points changed for the X direction vibration test full level.

-6dB random vibration test added using the new control

In order to complete the test in X direction the control point number was decreased from 4 to 3.

The following figure show the new control point positions.

The control was performed using
three columns instead of four

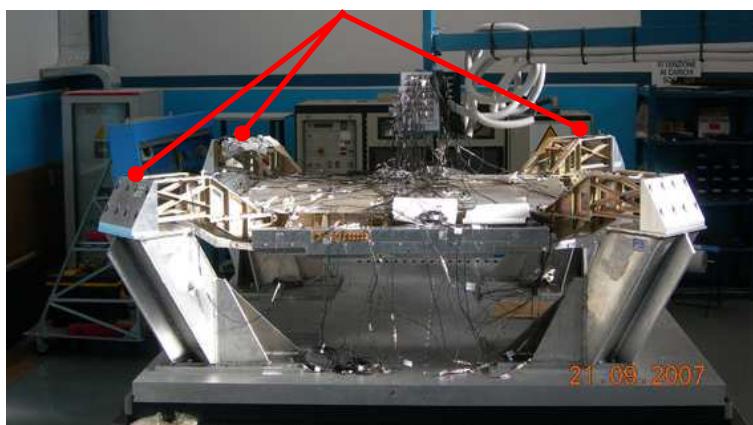


Figure 15-7 Control point number change

After the CP change a low level at -6dB run was added in order to evaluate some discrepancies.

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 21/09/07	Date	Date		Date

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PROCEDURE VARIATION SHEET ref. N°6 (page 2 of 3)

Test Procedure Ref.:		Page Revised:	Paragraph Revised:			
-AMS02-PR-CGS-004 UTOF vibration test procedure		Pg. 21	Par. 15.1			
-UTOF vibration test sequence		Pg. 28	Par. 16.1			
Description of Change:						
Shaker Control Points changed for the X direction vibration test full level. -6dB random vibration test added using the new control						
STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS		
2.4. A1	PERFORM THE RANDOM VIBRATION TEST AT LOW LEVEL (-6dB)	OK	OK			
2.4. A2	VISUAL INSPECTION OF THE TEST ARTICLE	No visual damages detected	No visual damages detected			
2.4. A3	VERIFY UUT RESPONSE AND NOTCHING IF REQUIRED	Freq. OK gRMS OK	Freq. OK gRMS OK	No discrepancies from the low level random tests with four control points. The full level random using three control points can be performed.		

Reason for Change				
The shaker control system used four Control Point on fixture support top, during the full level test in X direction the controller wasn't able to reach the full level since in high frequency one of the control point had too spectral row out of the control band. In particular the test stopped at -2dB level.				
For this reason one channel has been excluded from the control loop.				
In order to validate the new configuration an additional run was performed at -6dB and the obtained results have been compared to the -6dB test performed with the original CP.				

CONCURRENCE				
Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 21/09/07	Date	Date		Date

PROCEDURE VARIATION SHEET ref. N°6 (page 3 of 3)

Test Procedure Ref.:	Page Revised:	Paragraph Revised:
-AMS02-PR-CGS-004 UTOF vibration test procedure	Pg. 21	Par. 15.1
-UTOF vibration test sequence	Pg. 28	Par. 16.1

Reason for Change



Figure 0-1 MP used to evaluate the control change effect

The following figure show the worst case comparison (near the excluded control point) for MP outputs considering four and three control points.

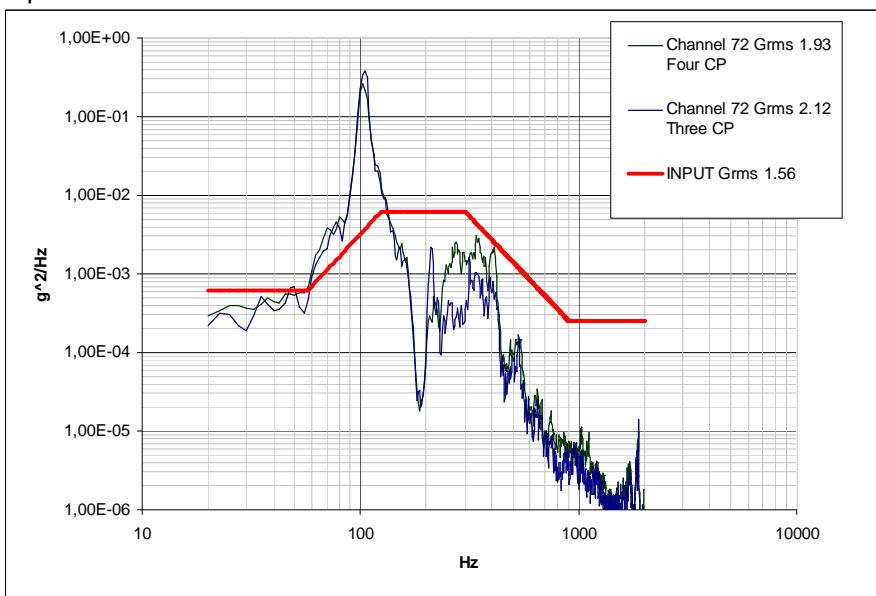


Figure 0-2 MP comparison considering four and three CP.

The acceleration levels transmitted to the UTOF structure have a negligible variation regarding to the CP changing.

CONCURRENCE

Test Cond G. Laurenti.	QA	System Eng.		Customer
Date 21/09/07	Date	Date		Date

16. TEST RESULTS

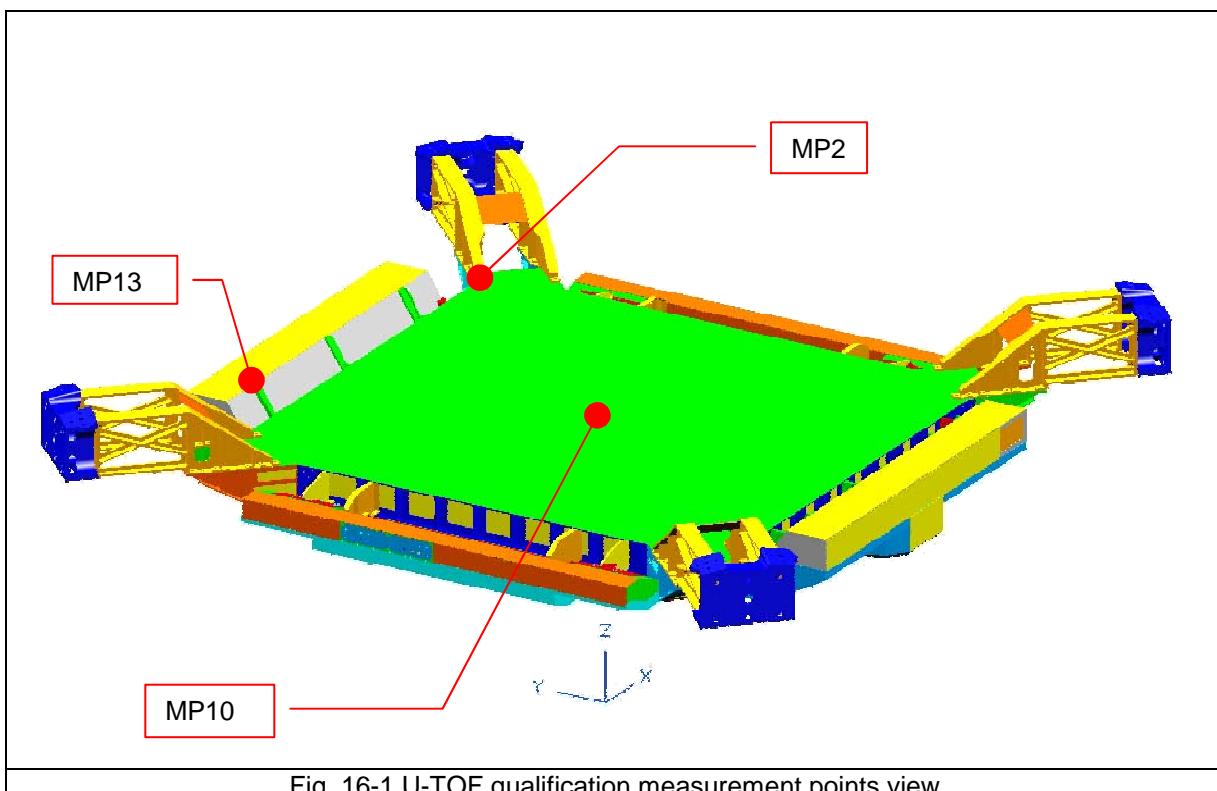
In the following chapters a resume of the test results is provided for each objective:

16.1 FREQUENCY IDENTIFICATION FOR X, Y AND Z AXIS

The following first modes have been identified:

- *Upper TOF First Mode hard mounted is $F_1 > 105$ Hz , for X direction*
- *Upper TOF First Mode hard mounted is $F_1 > 103$ Hz , for Y direction*
- *Upper TOF First Mode hard mounted is $F_1 > 38$ Hz , for Z direction*

The main plots showing the modes during random vibration at 0dB are displayed hereafter with a assessment of the mode shape based on the measures of MP 2 (near connection brackets) MP 10 (detector plate centre) and MP 13 (detector boxes):



Moreover no secondary modes involving global motion of the detector are identified.

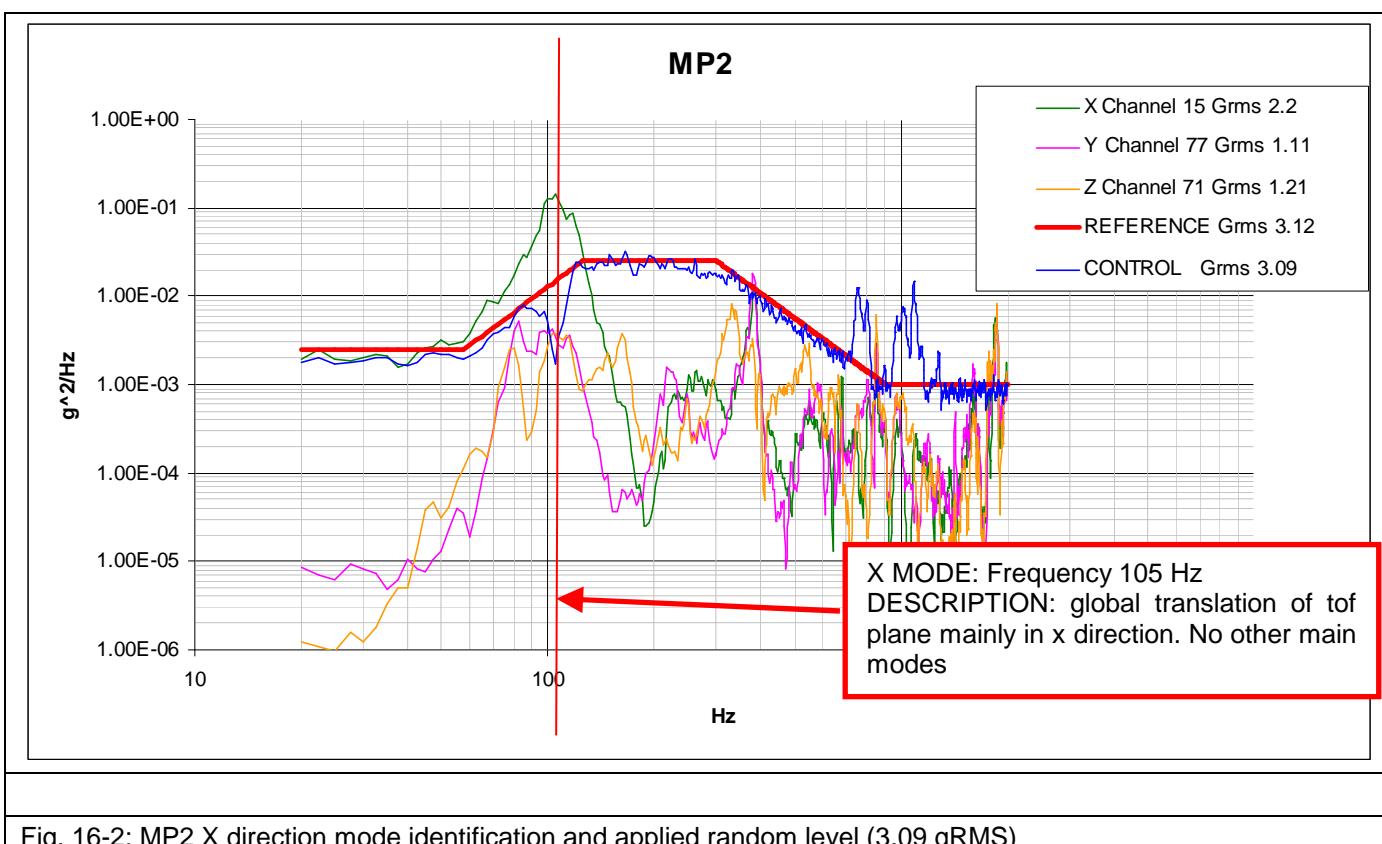


Fig. 16-2: MP2 X direction mode identification and applied random level (3.09 gRMS)

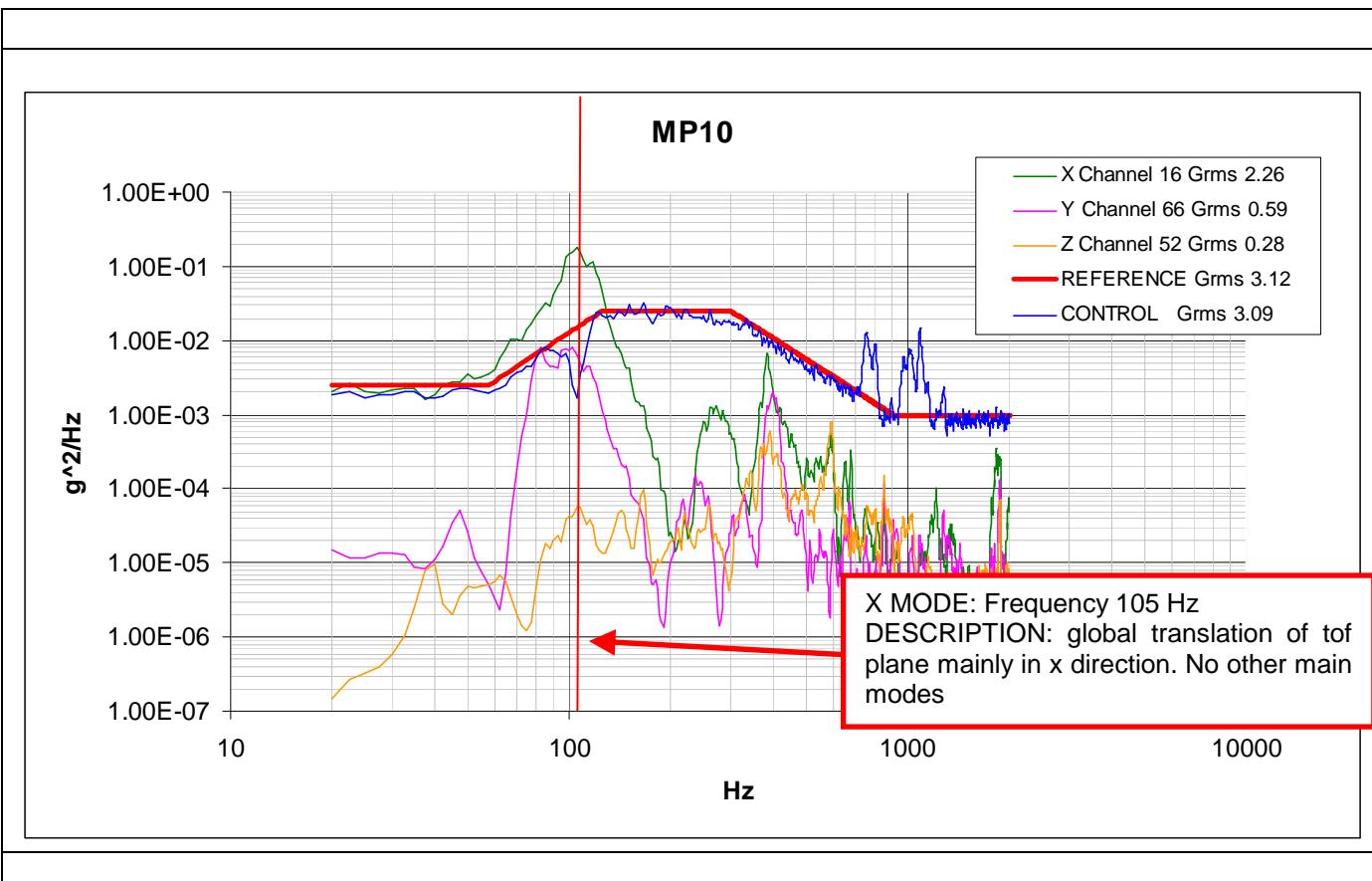


Fig. 16-3: MP10 X direction mode identification and applied random level (3.09 gRMS)

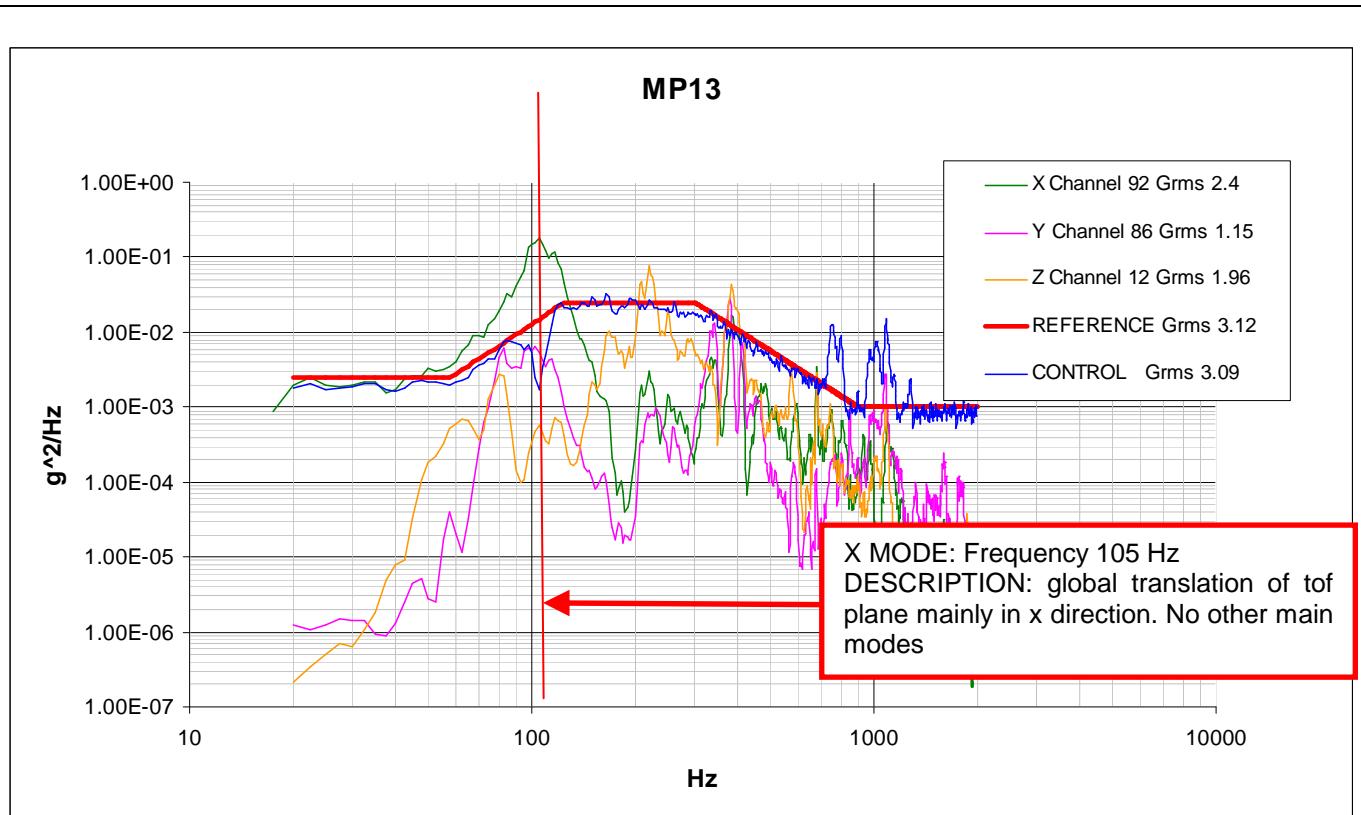


Fig. 16-4: MP13 X direction mode identification and applied random level (3.09 gRMS)

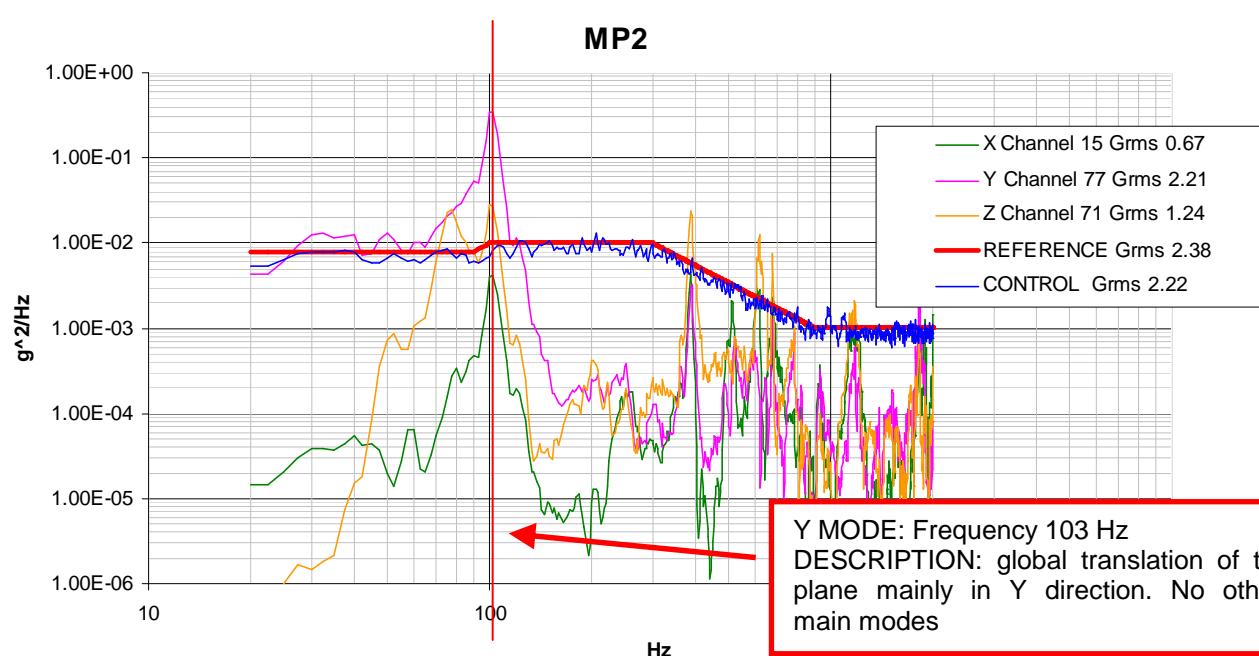


Fig. 16-5: MP2 Y direction mode and applied random level (2.22gRMS)

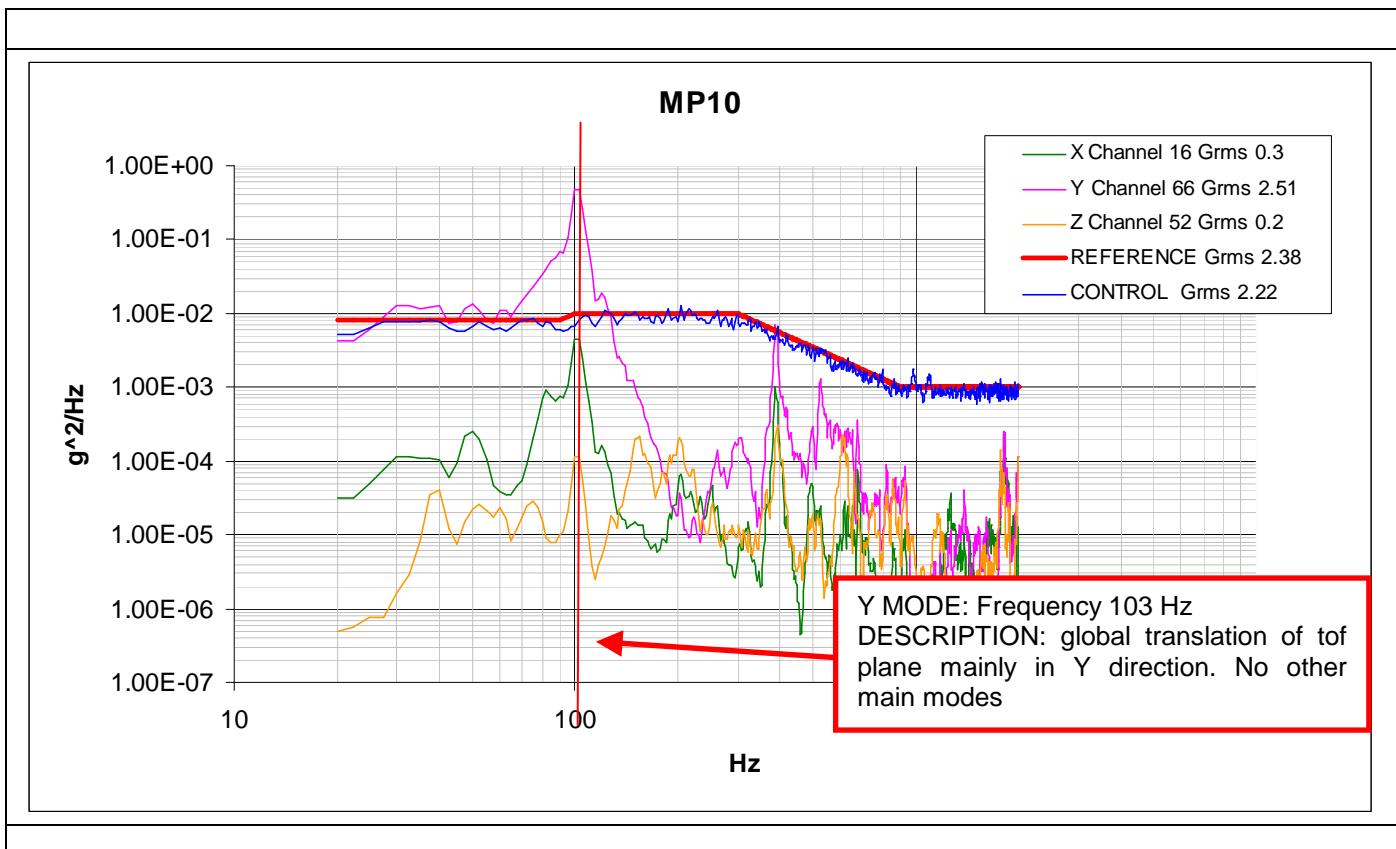


Fig. 16-6: MP10 Y direction mode and applied random level (2.22gRMS)

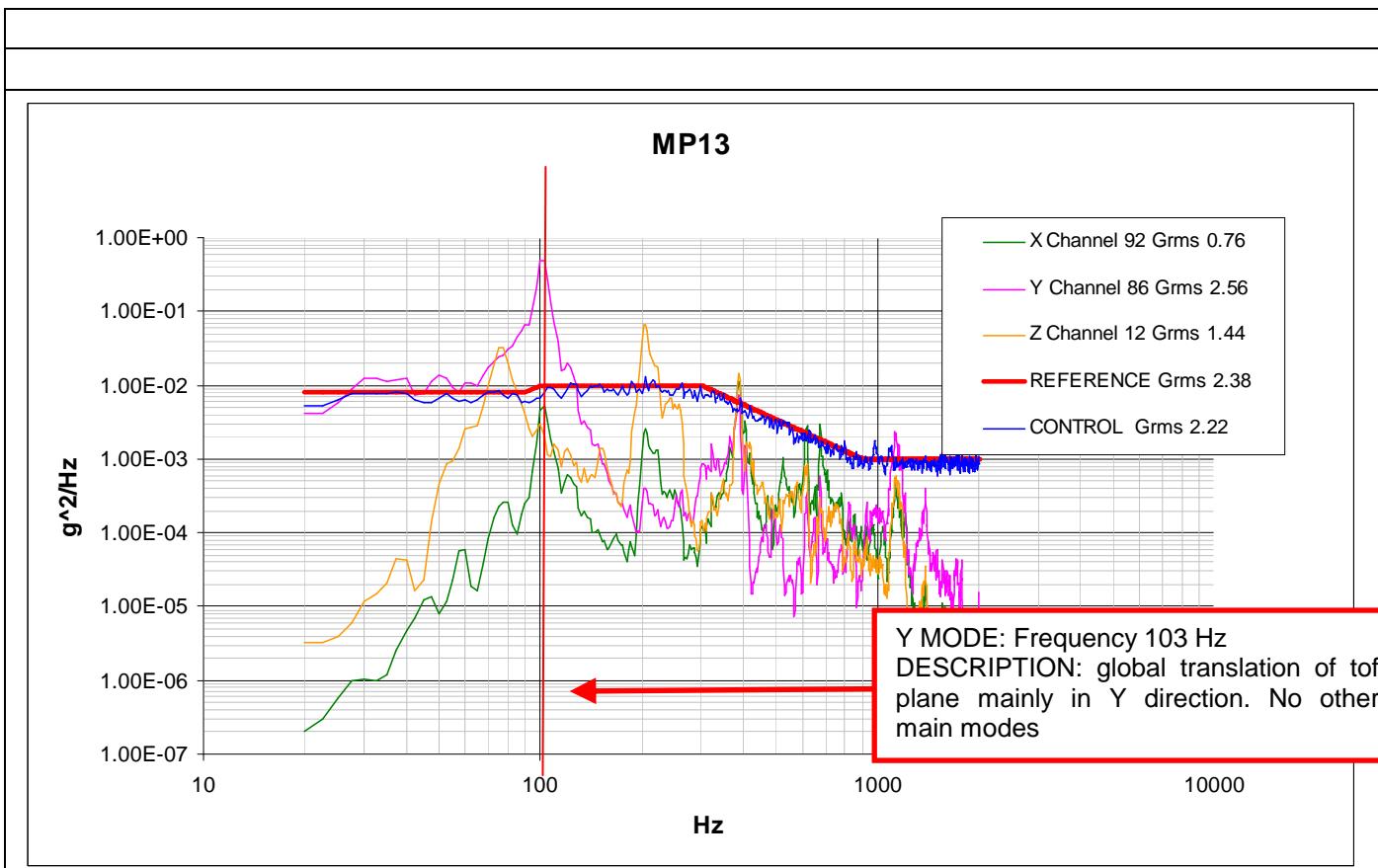


Fig. 16-7: MP13 Y direction mode and applied random level (2.22gRMS)

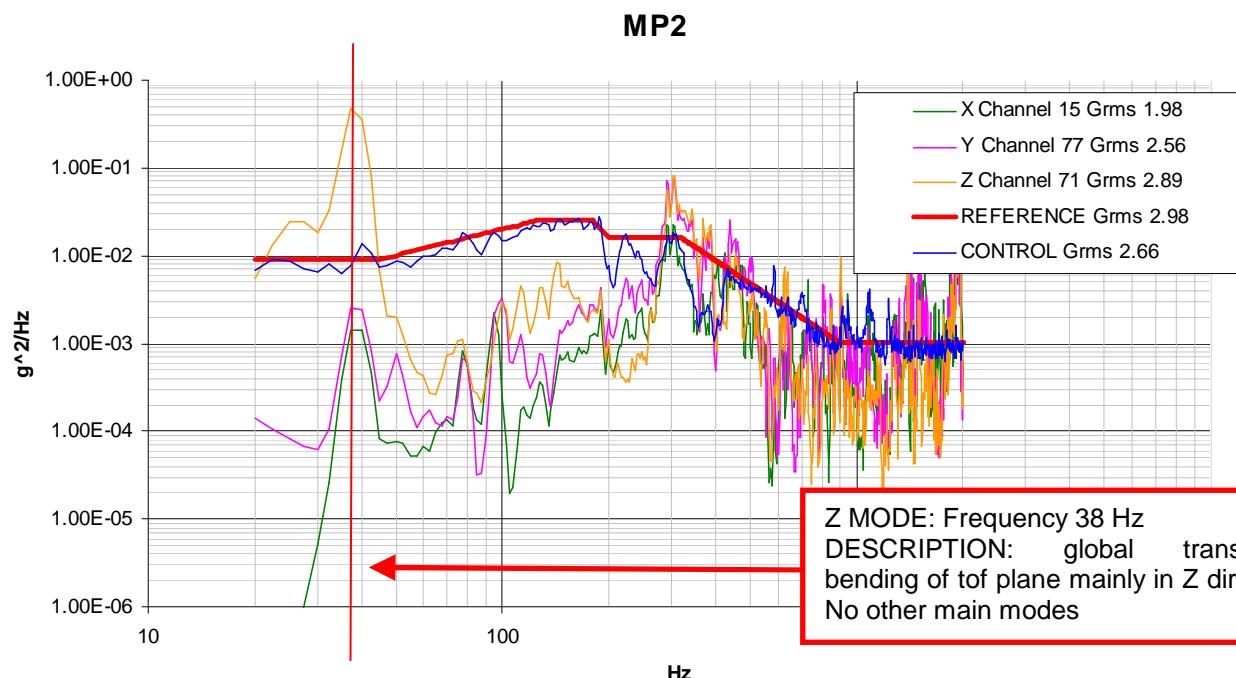


Fig. 16-8: MP2 Z direction mode and applied random level (2.66 gRMS)

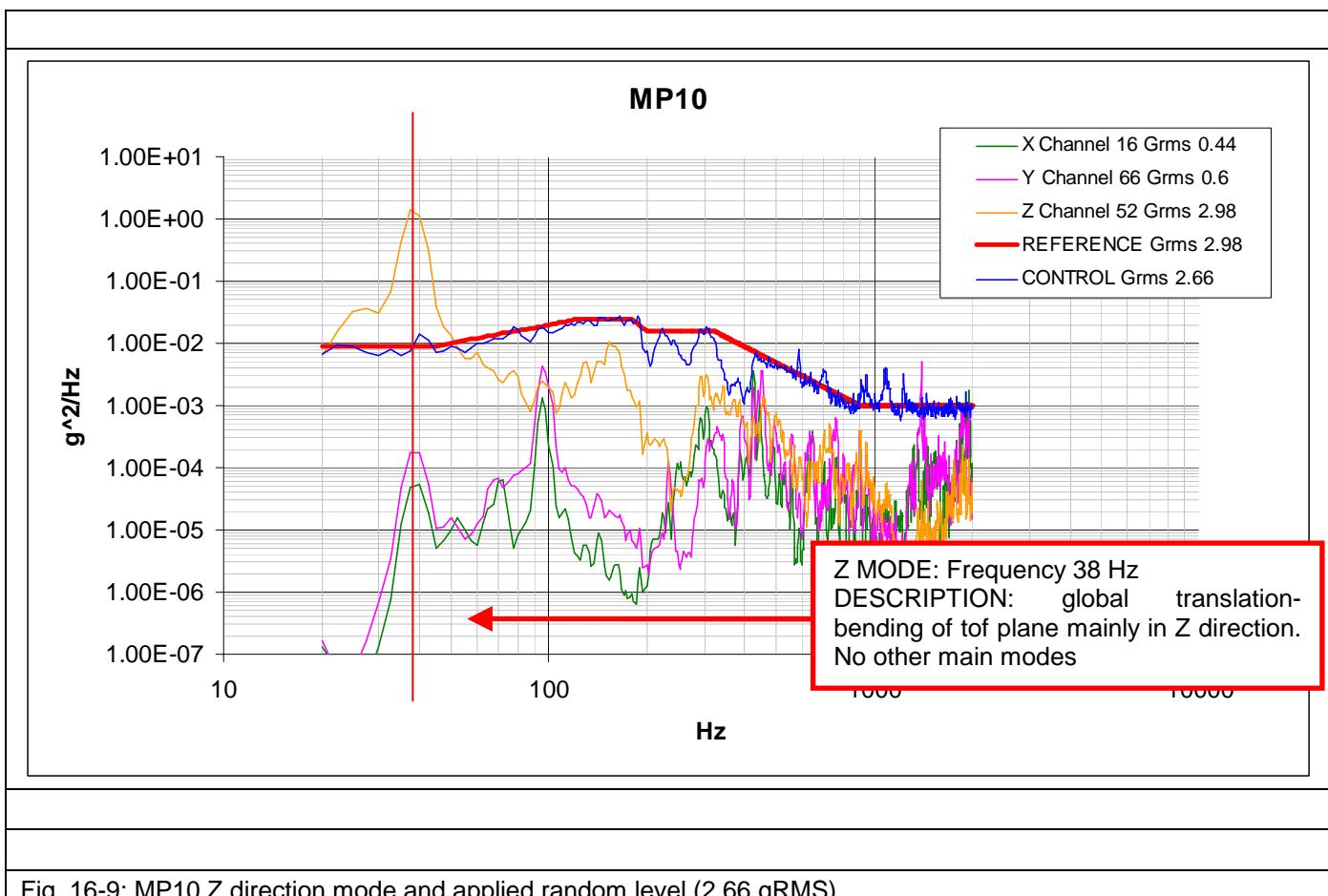


Fig. 16-9: MP10 Z direction mode and applied random level (2.66 gRMS)

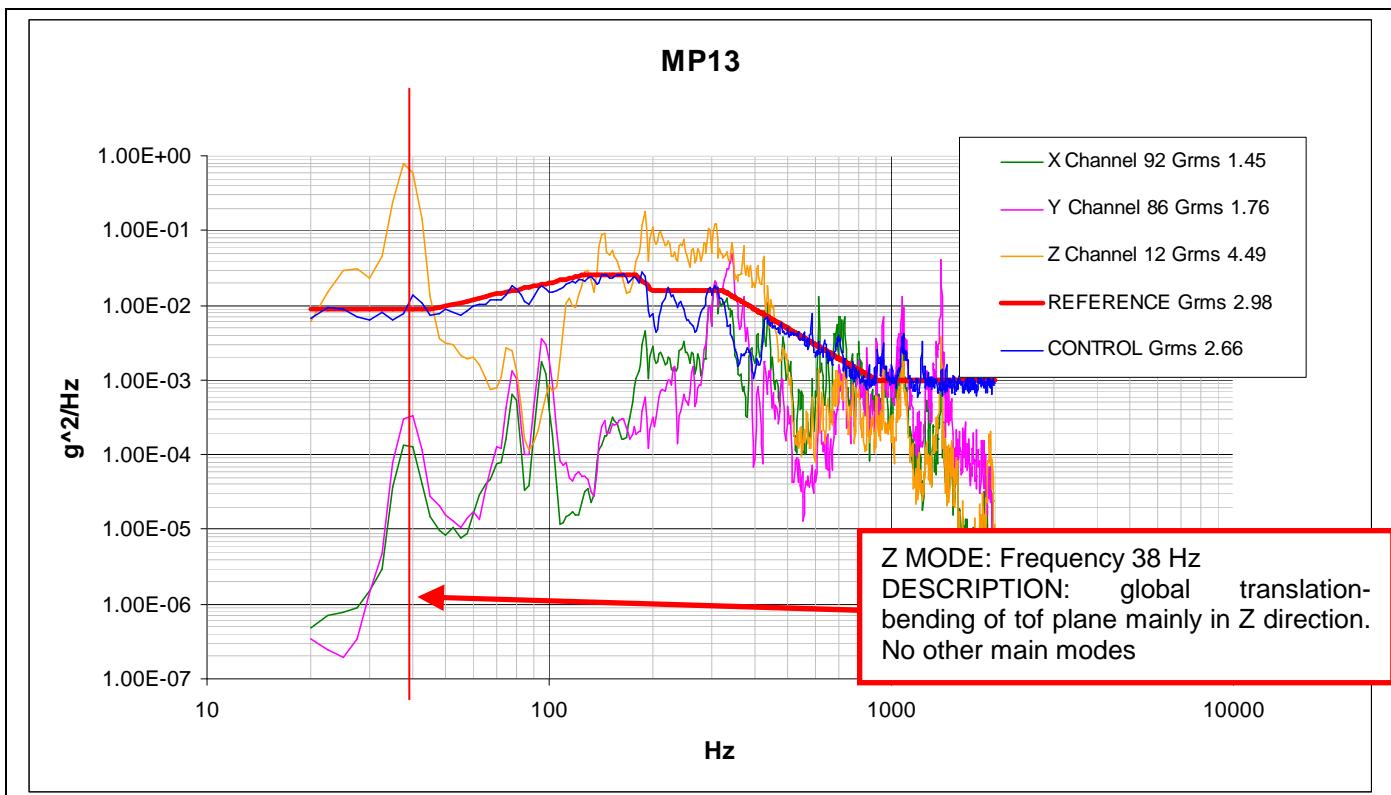


Fig. 16-10: MP13 Z direction mode and applied random level (2.66 gRMS)

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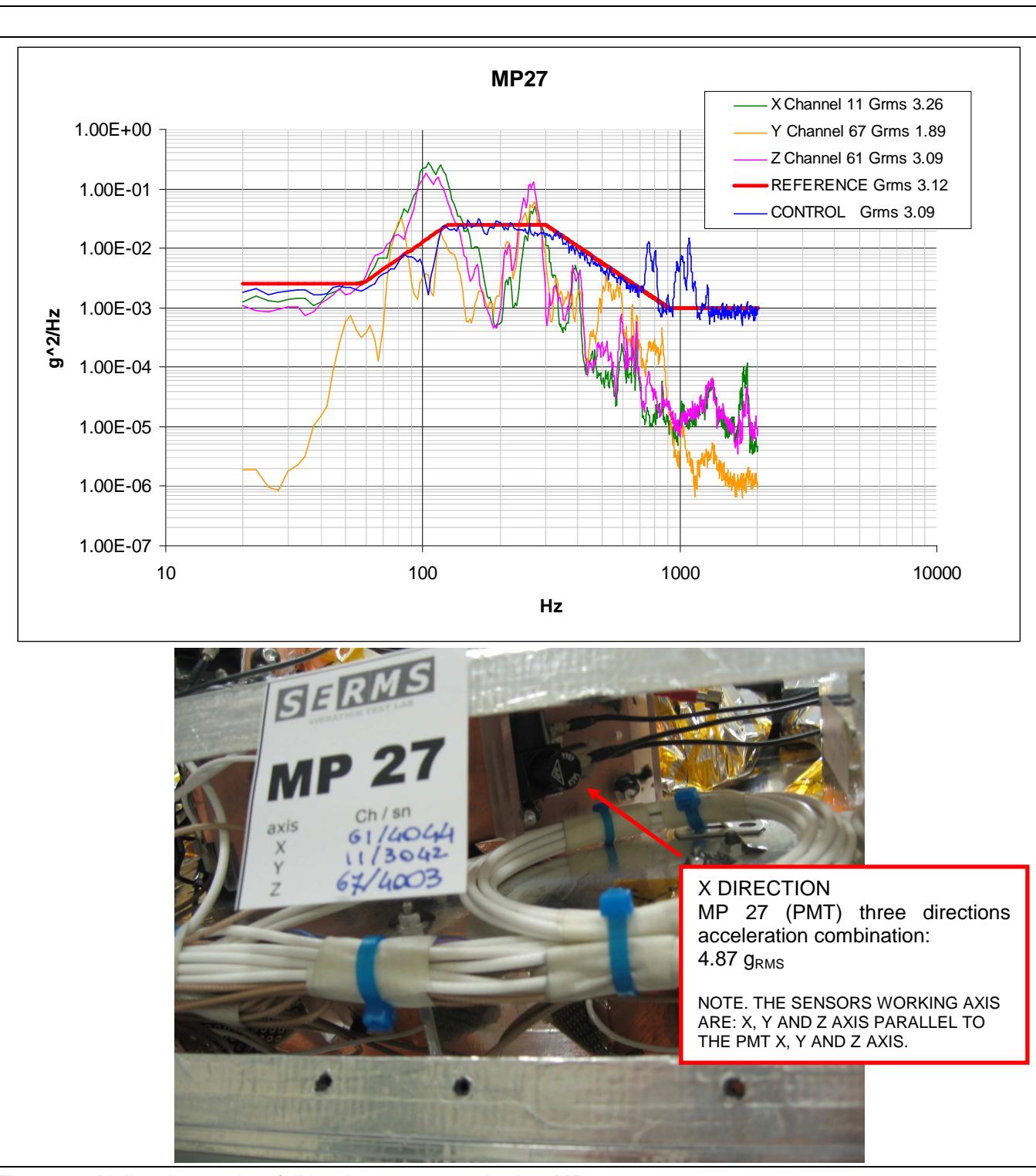
16.2 RANDOM VIBRATION ENVIRONMENT VERIFICATION

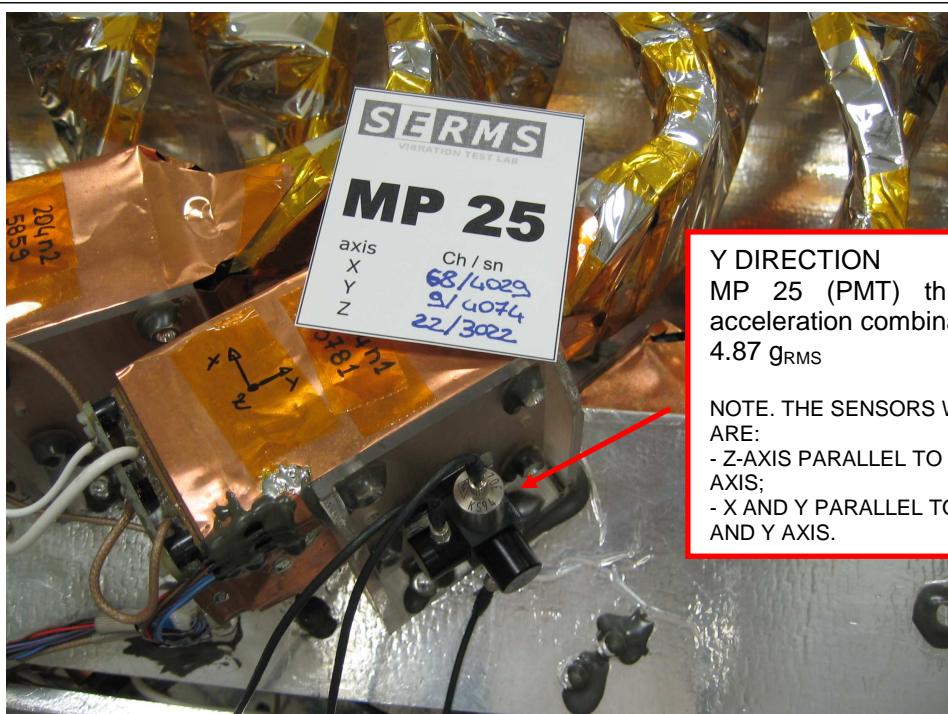
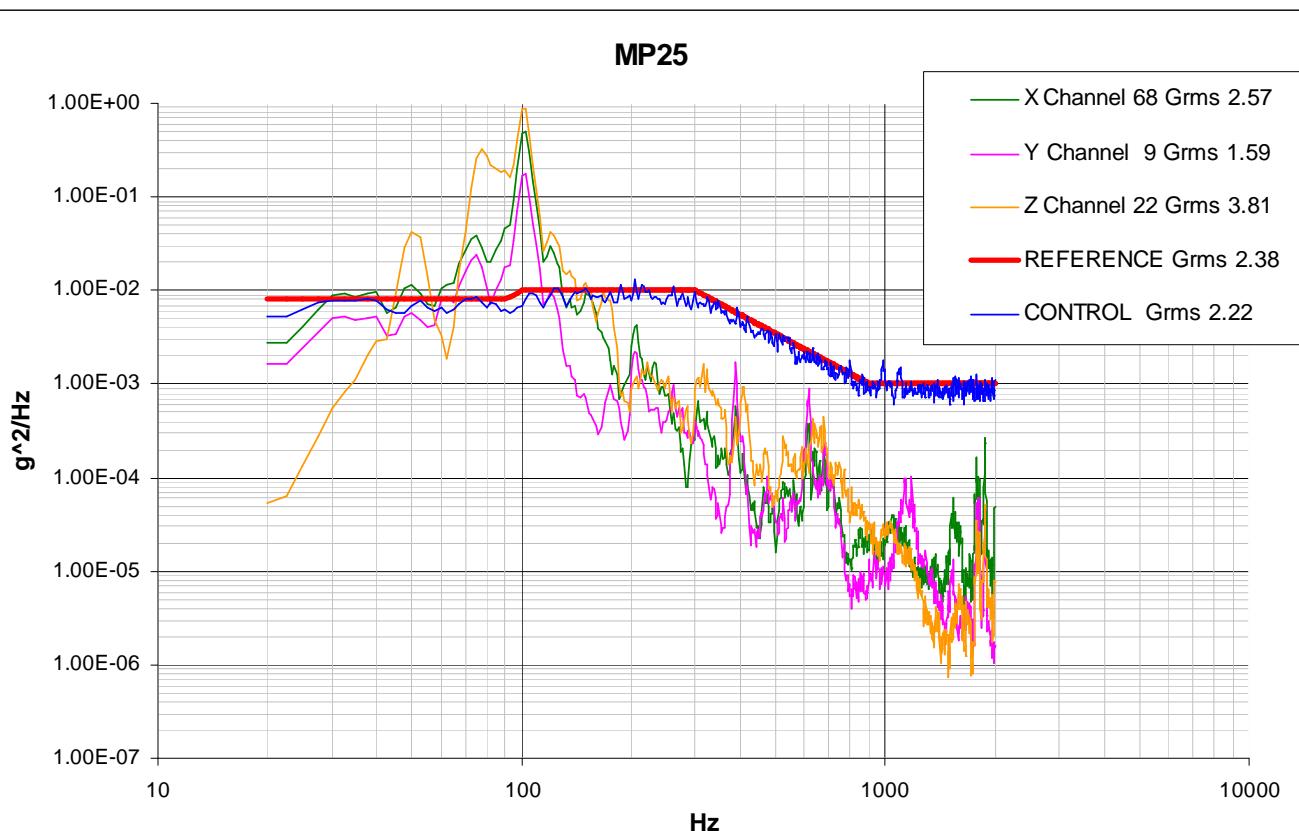
The testing of the structure was successfully performed using MEFL levels without notching for the X-Y directions, while for the Z direction the notching was applied.

- *Upper TOF Verification for Random Vibration successfully performed. No discrepancies between Resonance search plots before and after each random vibration were detected, moreover no deformation, damage or loose parts were detected during visual inspections.*
- *Maximum recorded level to the structure was: Z direction MP18 3.51 gRMS*
- *Maximum recorded levels to the PMTs monitored were:*
 - *Z direction -3dB MEFL level MP21 6.09 gRMS;*
 - *Z direction notched full level MP21 5.04 gRMS*

In the next plots the PMTs Measurement Points maximum outputs at random vibration full level are shown; in particular:

- X direction → MP27 (PMT);
- Y direction → MP25 (PMT);
- Z direction → MP21 (PMT).





Y DIRECTION
 MP 25 (PMT) three directions acceleration combination:
 4.87 g_{RMS}

NOTE. THE SENSORS WORKING AXIS ARE:
 - Z-AXIS PARALLEL TO THE UTOF Z-AXIS;
 - X AND Y PARALLEL TO THE PMT X AND Y AXIS.

Fig. 16-12: Y direction random full level response reached on MP25

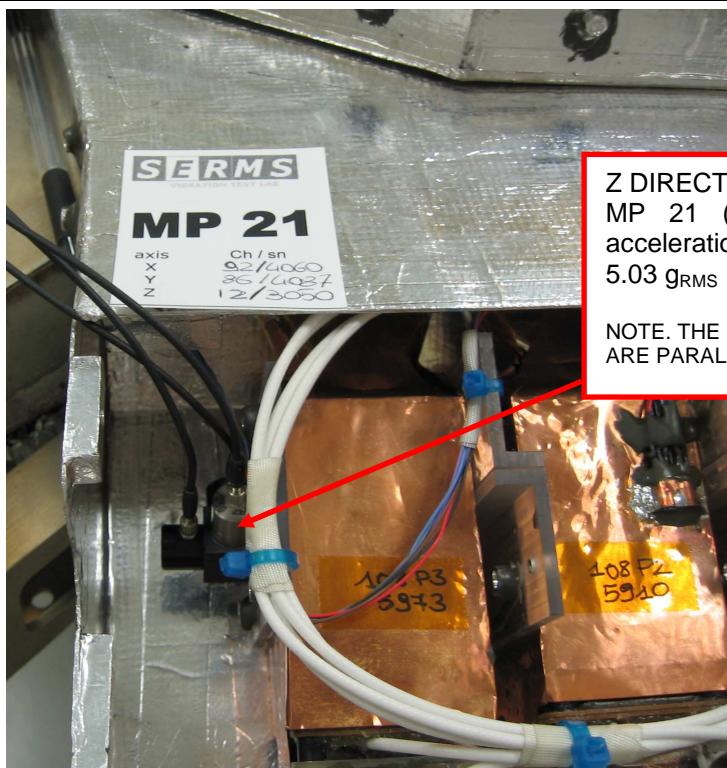
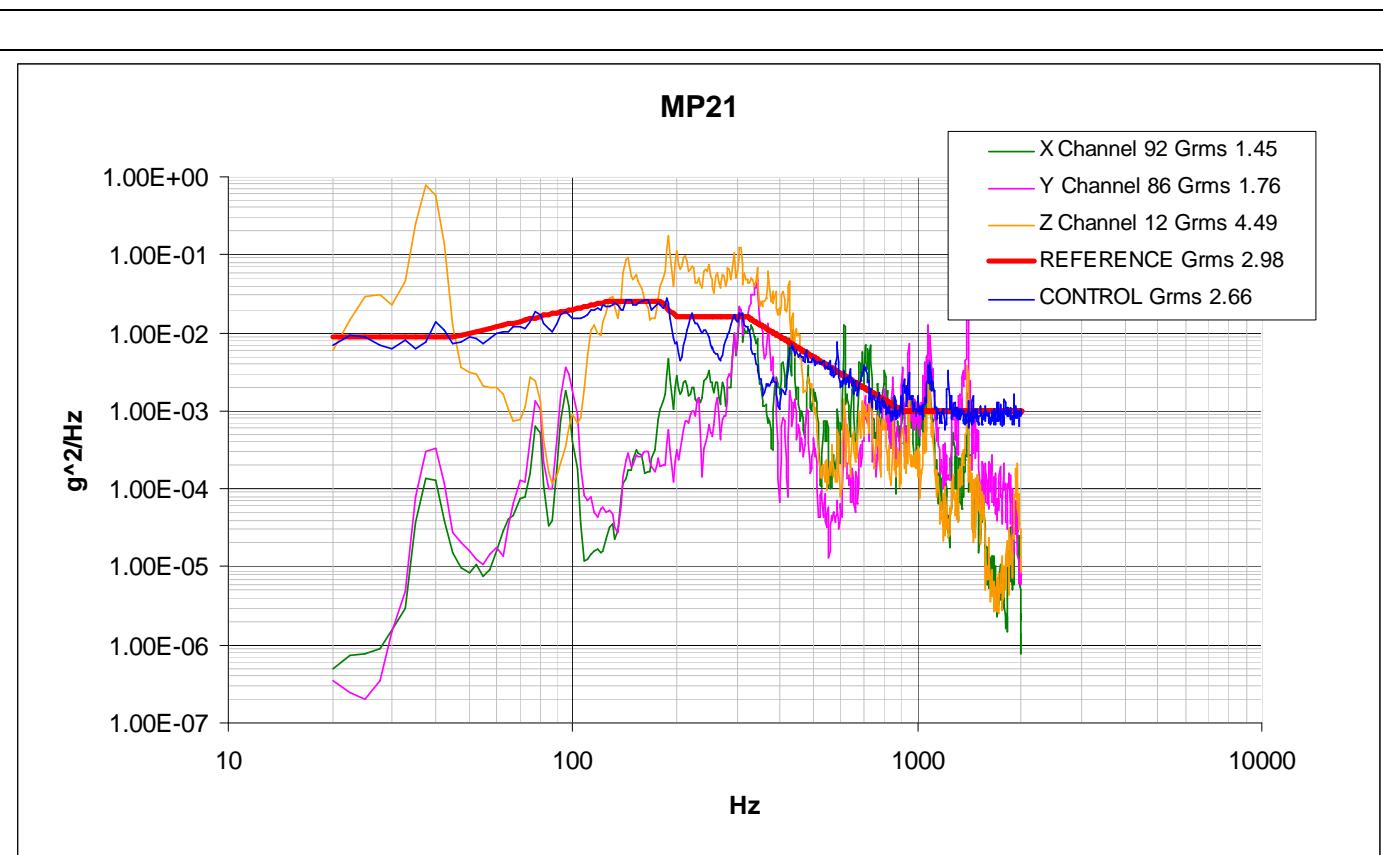


Fig. 16-13: Z direction random full level response reached on MP21

Finally in the next plots the comparison of the resonance search results before and after full level for representative channels is provided.

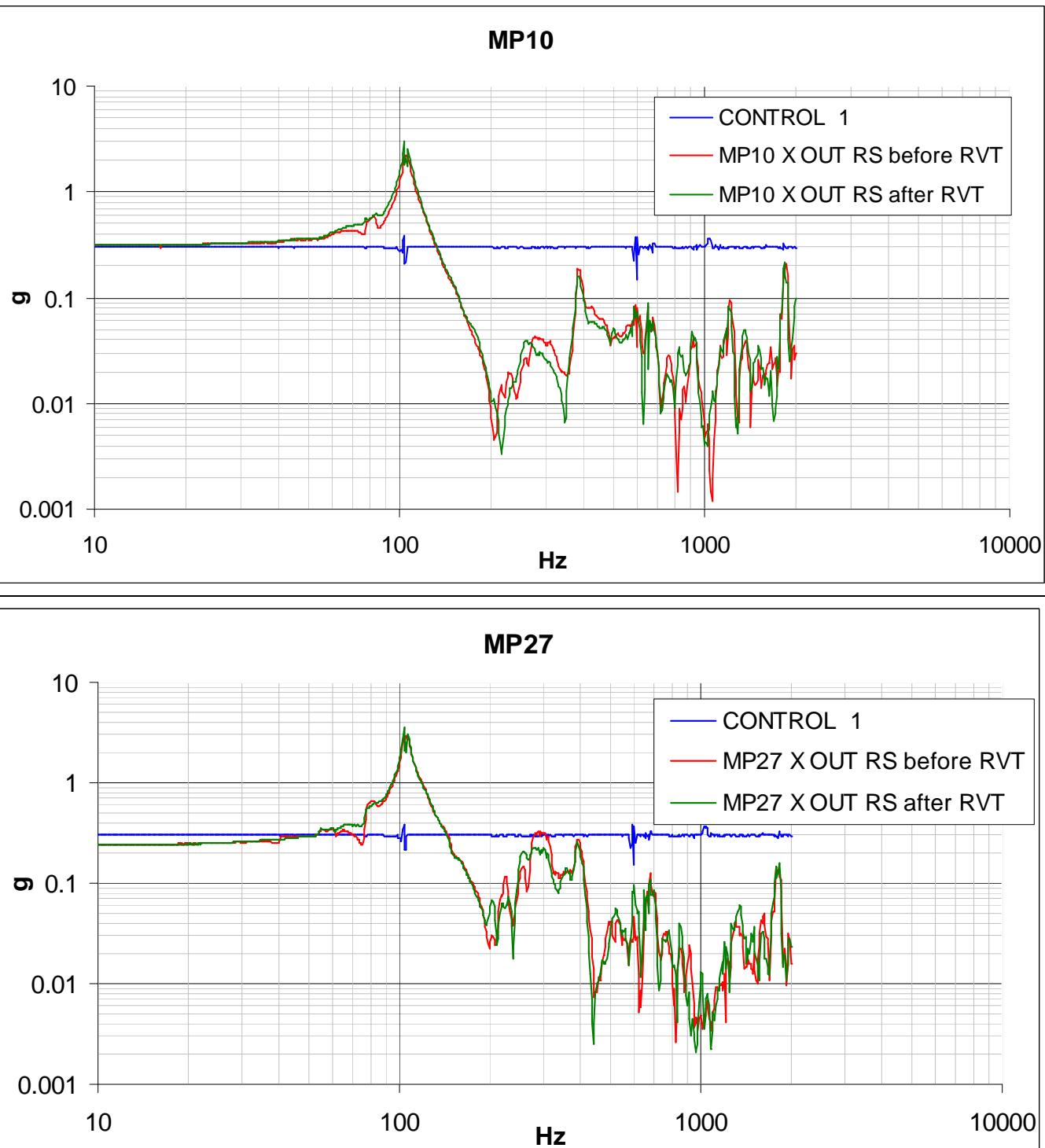
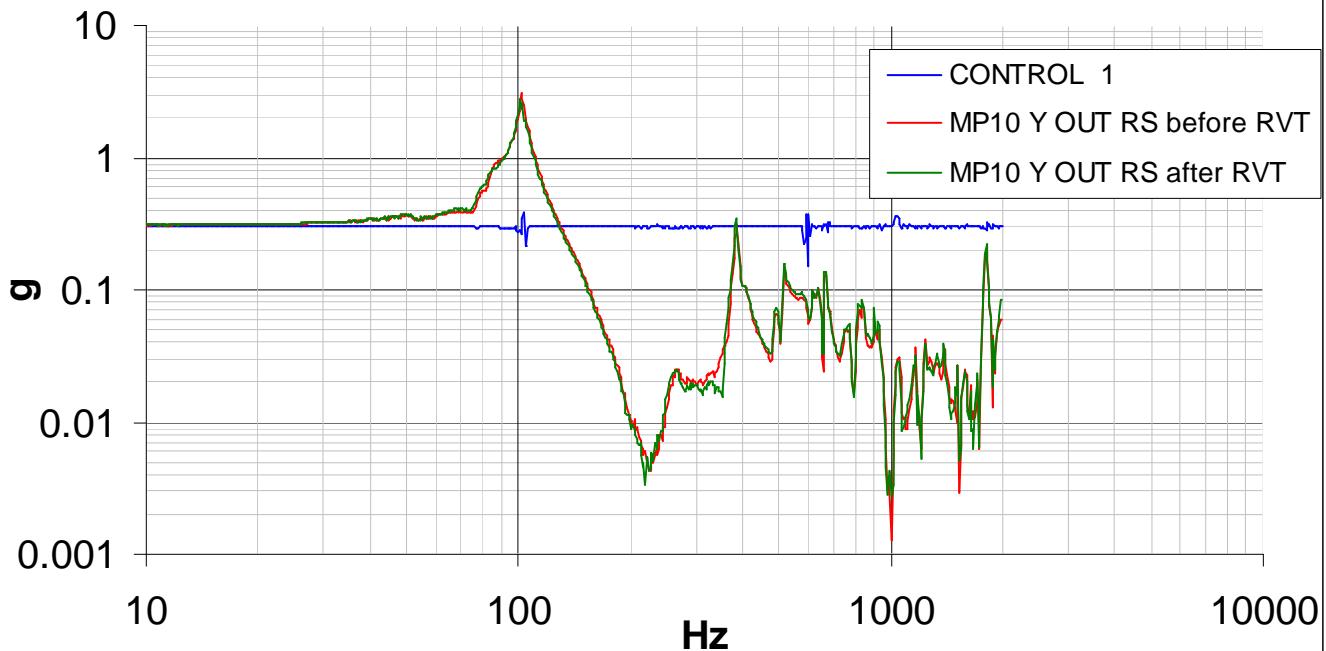


Fig. 16-14: X direction comparison of RS before and after full level

MP10



MP25

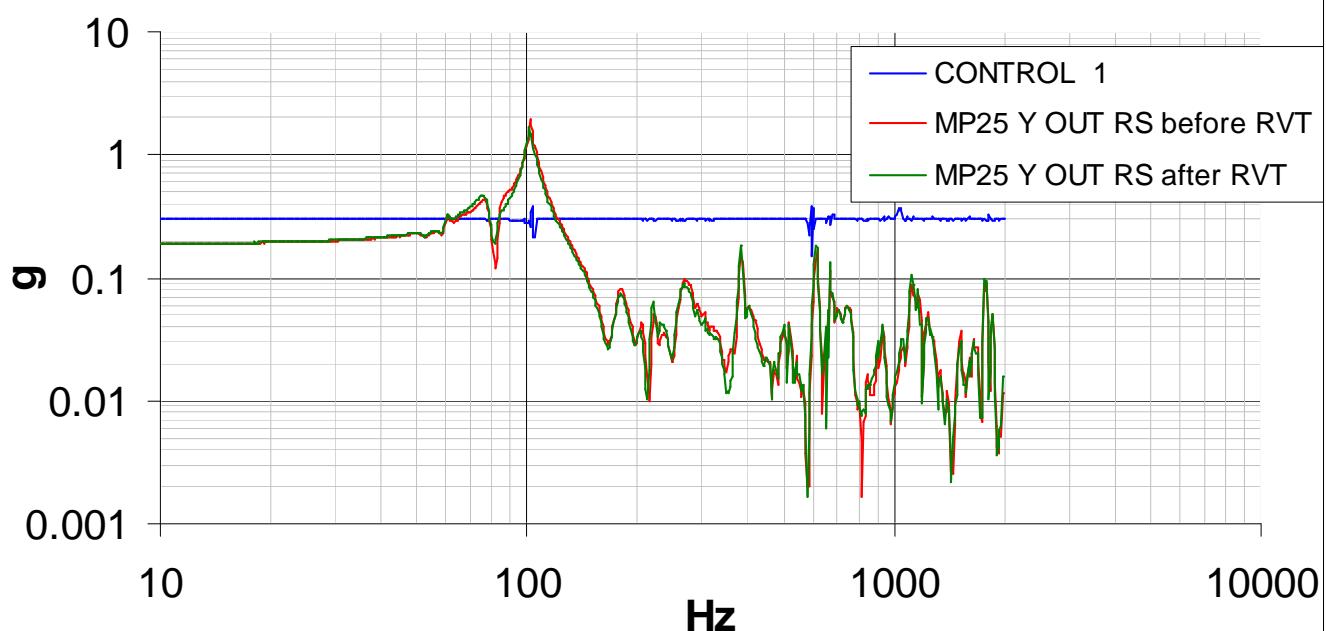
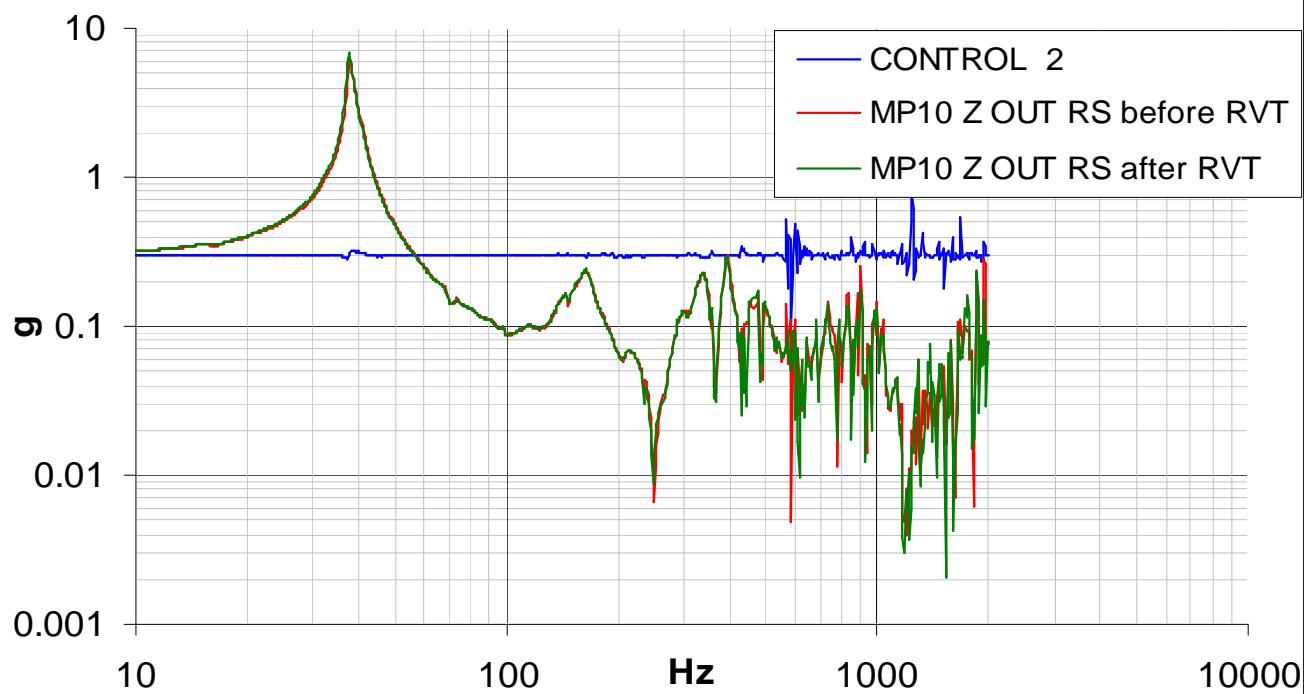


Fig. 16-15: Y direction comparison of RS before and after full level

MP10



MP21

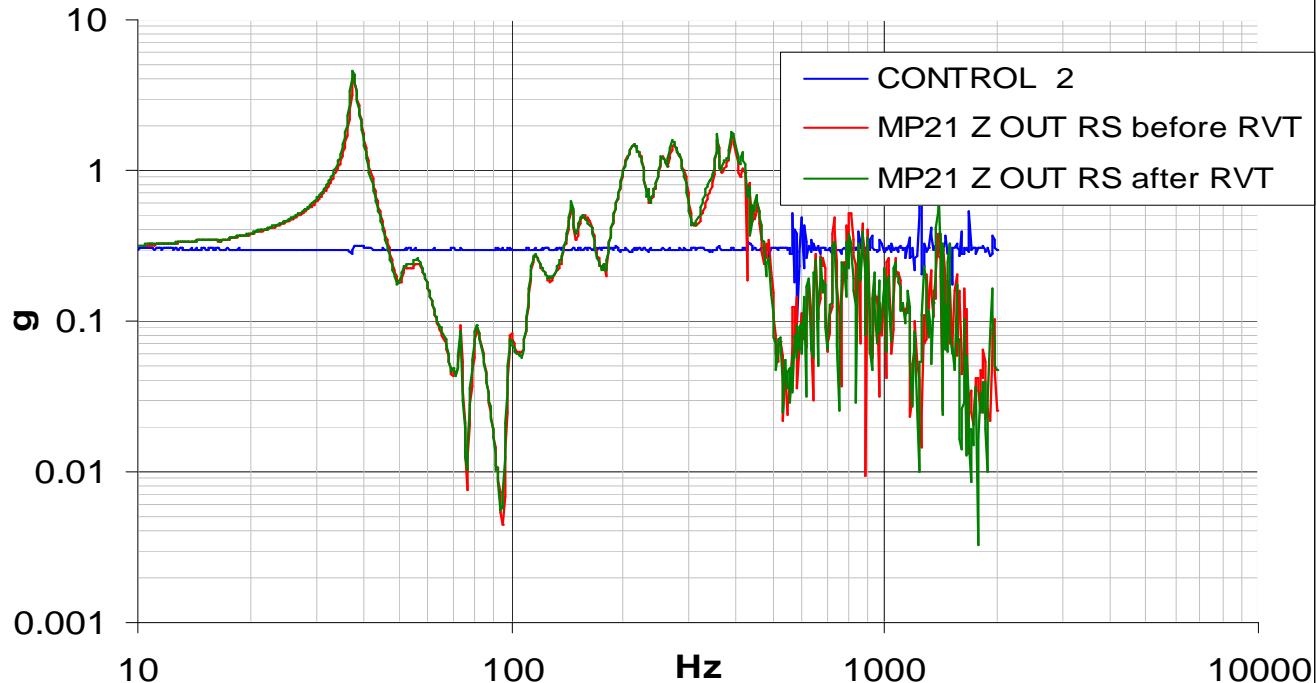


Fig. 16-16: Z direction comparison of RS before and after full level

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The plots are very well superimposed in all the frequency range demonstrating that the structure and all the detector components are unaffected by the MEFL vibration.

17. TEST CONCLUSIONS AND COMMENTS

The test allowed to successfully verify the following test objectives:

- UTOF minimum frequency hardmounted is $F_1=38$ Hz, for Z direction. This confirms the test prediction results (RD2), therefore the first UTOF frequency is $F_1>43.5$ Hz.
- UTOF survived the vibration environment without degradation. No discrepancies between Resonance search plots before and after each random vibration , deformation, damage or loose parts were identified.

18. TEST DATA SHEETS

The step-by-step procedure sheets are provided in the following pages.

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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
1.	UTOF TEST SETUP						
1.1.	REMOVE U-TOF FROM TRANSPORT CONTAINER				OK	OK	
1.2.	INSTALL INTERNAL ACCELEROMETERS				OK	OK	This operation was performed on 11/09/08
1.3.	INSTALL EXTERNAL ACCELEROMETERS				OK		This operation was performed on 17-18/09/08

DATE:11,17-18/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS

2.	TEST X AXIS			
2.1.	UNLOADED FIXTURE RESONANCE SEARCH			
2.1.1.	INSTALL FIXTURE ON SHAKER	OK	OK	
2.1.2.	FIX CONTROL ACCELEROMETERS TO FIXTURE	OK	OK	
2.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH	OK	OK	
2.1.4.	VERIFY PLOTS	Cross talk ok Amplif\degr .ok pilot and copilot ok	Cross talk ok Amplif\degr .ok pilot and copilot ok	
2.1.5.	COMPARE THE OBTAINED PLOTS WITH THE Tab 10-2 OF AD2	OK	OK	
2.1.6.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK	OK	

DATE:12-13/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS

2.2.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL			
2.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
2.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
2.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH	OK		
2.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS	F ₁ > 33.62 Hz PLOTS OK		

DATE: 20/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS

2.3.	LOW LEVEL RANDOM			
2.3.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-2 LOW LEVEL (-6 Db)	OK		
2.3.2.	PERFORM RANDOM VIBRATION	OK		
2.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
2.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
2.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
2.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
2.4.	FULL LEVEL RANDOM						

2.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-2 FULL LEVEL -0dB	OK		
2.4.2.	PERFORM RANDOM VIBRATION	OK		
2.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
2.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
2.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
2.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
2.5.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM						
2.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH				OK		
2.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE				OK		
2.5.3.	VERIFY PLOTS				freq shift ok amplif var. ok		
2.5.4.	CHECK INTERFACE BOLTS TORQUE				OK		
2.5.5.	REMOVE UUT FROM FIXTURE				OK		
2.5.6.	REMOVE FIXTURE				OK		

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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
3.	TEST Y AXIS						
3.1.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL						
3.1.1.	INSTALL UUT TO THE FIXTURE FOR Y DIRECTION VIBRATION						
3.1.2.	CONNECT MEASURE ACCELEROMETERS TO DAS				OK		
3.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH				OK		
3.1.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE				OK		
3.1.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS				F ₁ > 33.62 Hz PLOTS OK		

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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS	

3.2.	LOW LEVEL RANDOM			
3.2.1.	PROGRAM SHAKER ACCORDING TO CHP 13.2 LOW LEVEL (-6 Db)	OK		
3.2.2.	PERFORM RANDOM VIBRATION	OK		
3.2.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
3.2.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
3.2.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
3.2.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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STEP n°			TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS

3.3.	FULL LEVEL RANDOM			
3.3.1.	PROGRAM SHAKER ACCORDING TO CHP 13.2 FULL LEVEL -0dB	OK		
3.3.2.	PERFORM RANDOM VIBRATION	OK		
3.3.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
3.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
3.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
3.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

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UUT DATA :	Model FM	Item AMS UPPER TOF FM	C.I.	S/N	n.a.
STEP n°	TEST SEQUENCE		EXPECTED VALUE	MEASURED VALUE	REMARKS
3.4.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM				
3.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH		OK		
3.4.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE		OK		
3.4.3.	VERIFY PLOTS		freq shift ok amplif var. ok		
3.4.4.	CHECK INTERFACE BOLTS TORQUE		OK		
3.4.5.	REMOVE UUT FROM FIXTURE		OK		
3.4.6.	REMOVE FIXTURE		OK		

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4.	TEST Z AXIS			
4.1.	UNLOADED FIXTURE RESONANCE SEARCH			
4.1.1.	INSTALL FIXTURE ON SHAKER	OK		
4.1.2.	FIX CONTROL ACCELEROMETERS TO FIXTURE	OK		
4.1.3.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH	OK		
4.1.4.	VERIFY PLOTS	Cross talk ok Amplif\degr .ok pilot and copilot ok		
4.1.5.	COMPARE THE OBTAINED PLOTS WITH THE Tab 10-2 OF AD2	OK		
4.1.6.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		

DATE: 13-14/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS

4.2.	RESONANCE SEARCH BEFORE RANDOM LOW LEVEL			
4.2.1.	INSTALL UUT TO THE FIXTURE FOR X DIRECTION VIBRATION			
4.2.2.	CONNECT MEASURE ACCELEROMETERS TO DAS	OK		
4.2.3.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH	OK		
4.2.4.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK		
4.2.5.	FREQUENCY IDENTIFICATION AND EVALUATION OF PLOTS WITH RESPECT TO FEM PREDICTIONS	F ₁ > 33.62 Hz PLOTS OK		

DATE: 18/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
4.3.	LOW LEVEL RANDOM						

4.3.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-2 LOW LEVEL (-6 Db)	OK		
4.3.2.	PERFORM RANDOM VIBRATION	OK		
4.3.3.	ANNEX TO THE TEST REPORT RESPONSE FROM THE MPs AND SAVE FILE	OK		
4.3.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots		
4.3.5.	VERIFY COG ACCELERATION AND NOTCHING	OK		
4.3.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK		

DATE: 19/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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TEST REPORT REFERENCE

UUT DATA :		Model	FM	Item	AMS UPPER TOF FM	C.I.	S/N	n.a.
STEP n°	TEST SEQUENCE					EXPECTED VALUE	MEASURED VALUE	REMARKS

4.4.	FULL LEVEL RANDOM				
4.4.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-2 FULL LEVEL -0dB	OK			
4.4.2.	PERFORM RANDOM VIBRATION	OK			
4.4.3.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK			
4.4.4.	VERIFY PLOTS	No deformation No damage No loose parts No discrepancy wrt previous plots			
4.4.5.	VERIFY COG ACCELERATION AND NOTCHING	OK			
4.4.6.	VERIFY MONITOR CHANNELS ACCELERATION AND NOTCHING	OK			

DATE: 19/09/2007	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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TEST PROCEDURE REFERENCE

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UUT DATA :	Model FM	C.I.	S/N	n.a.	
STEP n°	TEST SEQUENCE	EXPECTED VALUE	MEASURED VALUE	REMARKS	
4.5.	RESONANCE SEARCH AFTER FULL LEVEL RANDOM				
4.5.1.	PROGRAM SHAKER ACCORDING TO Tab. 13-1 AND PERFORM RESONANCE SEARCH	OK			
4.5.2.	ANNEX TO THE TEST REPORT THE RECORDING CHART AND SAVE FILE	OK			
4.5.3.	VERIFY PLOTS	freq shift ok amplif var. ok			
4.5.4.	CHECK INTERFACE BOLTS TORQUE	OK			
4.5.5.	REMOVE UUT FROM FIXTURE	OK			
4.5.6.	REMOVE FIXTURE	OK			

DATE: 19/09/2007

TEST CONDUCTOR (INFN): G. LAURENTI

QA (INFN): G. LAURENTI

CUSTOMER (NA)



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UUT DATA :	Model	FM	Item	AMS UPPER TOF FM	C.I.	S/N	n.a.
STEP n°	TEST SEQUENCE				EXPECTED VALUE	MEASURED VALUE	REMARKS
5.	TEST SETUP DISMANTLING						
5.1.	REMOVE FROM U-TOF THE INTERNAL AND EXTERNAL ACCELEROMETERS				OK		
5.2.	INSERT U-TOF ON TRANSPORT CONTAINER READY FOR SHIPMENT				OK		

DATE:	TEST CONDUCTOR (INFN): G. LAURENTI	QA (INFN): G. LAURENTI	CUSTOMER (NA)
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